# LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

## Volume 5 | Technical Appendices

**Scope and methodology report addendum (CT-001-000/2)**

November 2013

VOL 5

ES 3.5.0.15.2

# LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

## Volume 5 | Technical Appendices

**Scope and methodology report addendum (CT-001-000/2)**

November 2013

ES 3.5.0.15.2

Department for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

A report prepared for High Speed Two (HS2) Limited.

High Speed Two (HS2) Limited,
Eland House,
Bressenden Place,
London SW1E 5DU

Details of how to obtain further copies are available from HS2 Ltd.

Telephone: 020 7944 4908

General email enquiries: HS2enquiries@hs2.org.uk

Website: www.hs2.org.uk

High Speed Two (HS2) Limited has actively considered the needs of blind and partially sighted people in accessing this document. The text will be made available in full on the HS2 website. The text may be freely downloaded and translated by individuals or organisations for conversion into other accessible formats. If you have other needs in this regard please contact High Speed Two (HS2) Limited.

recycle

Printed in Great Britain on paper
containing at least 75% recycled fibre.

# HS2 London-West Midlands

# Addendum to the EIA Scope and Methodology Report

## A report to HS2 Ltd by Arup/URS

# Contents

**List of tables**

**List of SMR tables**



**List of annexes**

# 1 Introduction

## 1.1 Purpose of this Addendum

1.1.1 The HS2 Scope and Methodology Report (SMR)( Volume 5: Appendix CT-001-000/1) was published in Autumn 2012 and set out the proposed scope and methodology for the Environmental Impact Assessment (EIA) for Phase 1 (London-West Midlands) of HS2.

1.1.2 This SMR Addendum outlines where the methodology presented within the SMR has been amended or advanced as a result of:

- legislation or industry best practice guidance having changed;
- the methodology having undergone refinement as a result of its application within the EIA; and
- further feedback on the outlined methodology having been received from stakeholders including statutory bodies following the ongoing application of that methodology.

1.1.3 This addendum generally focuses on updates and refinement to:

- the establishment of the baseline and definition of the survey;
- the scope of the assessment; and
- the assessment methodology.

1.1.4 There has been no material change to Part A of the SMR, including the report's Introduction, the high level methodology presented within the 'EIA Methodology' section, and the reporting of scheme alternatives considered. The scope and methodology contained within this addendum is generally presented in the future tense to emulate the SMR (which, being a consultation document in advance of the EIA was provided in the future tense).

1.1.5 The detailed assessment methodology is collated and presented in one or more Technical Notes for some of the topic areas under assessment. These are appended to this addendum. Not all topics have required the preparation of technical notes.

1.1.6 The addendum is arranged by topic area in the same order as they are presented within the SMR. It should be noted that for ease of cross reference, the section numbering of the remainder of this addendum document reflects the numbering utilised within the SMR document. Thus Sections 2 and 3 of this document are unused. Each section commences with a list of amendments to the SMR for the particular topic.

# 2 (not used)

# 3 (not used)

# 4 Agriculture, forestry and soils

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 4.5.1 | Supplementary text provided within SMR Addendum. |
| 4.6.6 | Paragraph deleted and replacement text provided within SMR Addendum. |
| 4.6 | Supplementary text provided as new paragraphs and tables after 4.6.15 within SMR Addendum |
| 4.6.15 | Paragraph deleted |
| 4.6.16 | Paragraph deleted |
| 4.6.17 | Paragraph deleted |
| 4.6.18 | Paragraph deleted |
| 4.6.19 | Paragraph deleted |

## 4.1 Scope of Assessment

### Spatial scope

4.1.1 *[paragraph 4.5.1 supplemented with:]* Baseline agricultural land quality and farm holding data will initially be collected for a 200m-wide corridor centred on the Proposed Scheme alignment, as the full extent of the study area (which equates to all agricultural land required for the construction of the Proposed Scheme) will be uncertain at the time of baseline work, although there will be a need for flexibility in the study area where off-site works are anticipated to extend beyond this limit.

## 4.2 Assessment methodology

### Planning policy

4.2.1 *[paragraph 4.6.6 amended to:]* There is no guidance in policy with regard to the effects of development proposals on farm holdings. Although Natural England's Technical Information Note (TIN) 049 indicates that land quality is not the sole consideration in how development proposals affect agricultural land in the planning system, it no longer refers to other relevant factors such as the impact on farm size and structure, the use of buildings and other fixed equipment, or any stimulus a development might give to rural economic activity. Instead, the updated TIN 049 indicates that planning authorities are guided by the National Planning Policy Framework to protect and enhance soils more widely, including for example conserving soil resources during construction and preventing soil from being adversely affected by pollution.

### Significance criteria

4.2.2 *[Supplementary text provided as new subheadings, paragraphs and tables after4.6.15:]*

*Agricultural receptors (farms and other rural land-based businesses)*

4.2.3 The nature of impacts will comprise primarily the loss of land to the farm holding (permanent and temporary), the severance of land (permanent and temporary), the loss of key farm infrastructure (dwellings, buildings and other structures such as irrigation reservoirs and slurry pits) and the imposition of disruptive effects (such as noise and dust) on land uses and the holding's operations.

4.2.4 Guideline criteria are presented in Table A. Where a farm holding experiences different levels of impact according to the nature of impact, the higher level will be assigned. Thus, for example, a farm holding that will lose 15% of its land (medium impact) but will retain access to severed land via a private means of access (low impact) will be assessed as incurring a medium impact.

Table A: Impact magnitude criteria for farm holdings

| **Impact magnitude** | **Definitions** | | | |
|---|---|---|---|---|
| | **Land required** | **Severance** | **Infrastructure** | **Disruptive effects** |
| High | >20% of all land farmed | No access available to severed land | Direct loss of farm dwelling, building or structure | Disruption discontinues land use or enterprise |
| Medium | >10% - 20% of all land farmed | Access available to severed land via the public highway | Loss of or damage to infrastructure affecting land use | Disruption necessitates change to scale or nature of land use or enterprise |
| Low | > 5% - 10% of all land farmed | Access available to severed land via private way | Infrastructure loss/damage does not affect land use | Disruption does not affect land use or enterprise |
| Negligible | 5% or less of all land farmed | No new severance | No impact on farm infrastructure | No disruption on land use or enterprise |

4.2.5 The sensitivity of receptors will be determined by the extent to which they have the capacity to absorb or adapt to impacts, which will be determined primarily by their nature and scale.

4.2.6 In general terms, larger farm holdings will have a greater capacity to absorb impacts and will be less sensitive. However, the scale of the land holding is reflected in the magnitude of impact and the percentage land take from the farm. For example, the loss of 100 hectares from a 400-hectare (1,000 acre) farm would be a high impact (25%) whereas the same land take from a 1,000-hectare farm would be low (10%). The sensitivity criteria therefore concentrate on the nature of the receptor in order to avoid giving undue weight to the scale of operations. They are presented in Table B.

Table B: Agriculture receptor sensitivity criteria

| Receptor sensitivity | Definition |
|---|---|
| High | Farm types in which the operation of the enterprise is dependent on the spatial relationship of land to key infrastructure, and where there is a requirement for frequent and regular access between the two, or dependent on the existence of the infrastructure itself, e.g.:<br>• Dairying, in which milking cows must travel between fields and the parlour at least twice a day;<br>• Irrigated arable cropping and field-scale horticulture, which are dependent on irrigation water supplies;<br>• Intensive livestock or horticultural production which is undertaken primarily within buildings, often in controlled environments. |
| Medium | Farm types in which there is a degree of flexibility in the normal course of operations, e.g.:<br>• Combinable arable farms;<br>• Grazing livestock farms (other than dairying). |
| Low | Farm types and land uses undertaken on a non-commercial basis. |

4.2.7 The significance of an effect will be a product of the magnitude of the impact and the sensitivity of the receptor, as summarised in Table C.

Table C: Significance of effect criteria

| Significance | | Impact magnitude | | | |
|---|---|---|---|---|---|
| | | **High** | **Medium** | **Low** | **Negligible** |
| Sensitivity of receptor | High | Major – significant | Major/<br>Moderate – significant | Moderate – significant | Minor – not significant |
| | Medium | Major/<br>Moderate – significant | Moderate – significant | Minor – not significant | Negligible – not significant |
| | Low | Moderate - significant | Minor – not significant | Negligible – not significant | Negligible – not significant |

*Agricultural land*

4.2.8 The areas of different grades of agricultural land that will be affected by the Proposed Scheme will be measured within each CFA, and summarised in the categories shown in Table D which reflect the Defra database and maps, 'Likelihood of Best and Most Versatile Agricultural Land' . The maps show:

- areas of High Likelihood, where more than 60% of the land is likely to be Best and Most Versatile;
- areas of Moderate Likelihood, where 20% to 60% of the land is likely to be Best and Most Versatile;
- areas of Low Likelihood, where less than 20% of the land is likely to be Best and Most Versatile; and
- other non-agricultural use, such as woodland.

Table D: Impact magnitude criteria for agricultural land

| Impact magnitude | Definitions |
|---|---|
| High | More than 60% of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile land |
| Medium | 20% - 60% of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile land |
| Low | Less than 20% or less than 10ha of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile land |
| Negligible | Less than 2% of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile agricultural land |

4.2.9 The sensitivity of resources affected will be determined by their inherent value, as reflected in their ALC grade, within the context of the abundance of agricultural land in the locality, defined as a 4-km corridor centred on the Proposed Scheme, as demonstrated in Table E.

Table E: Agriculture resources sensitivity criteria

| Resources sensitivity | Definition |
|---|---|
| High | Best and most versatile agricultural land where 'Low Likelihood of best and most versatile agricultural land' is the most extensive category in a 4km-wide corridor according to the Defra Likelihood maps |
| Medium | Best and most versatile agricultural land where 'Moderate Likelihood of best and most versatile agricultural land' is the most extensive category in a 4km-wide corridor according to the Defra Likelihood maps |
| Low | Best and most versatile agricultural land where 'High Likelihood of best and most versatile agricultural land' is the most extensive category in a 4km-wide corridor according to the Defra Likelihood maps |

4.2.10 The significance of an effect will be a product of the magnitude of the impact and the sensitivity of the receptor, as summarised in Table C.

*Forestry land*

4.2.11 Woodlands are an important natural resource as they offer soil protection, water regulation and carbon storage, and provide wood products and support forest industries.

4.2.12 This assessment will consider the impact on forestry land and woodland in a quantitative fashion, as a land use feature. It will not assess the qualitative impacts on woodland or forestry, for which reference needs to be made principally to the Ecology and Landscape and visual assessments.

4.2.13 The nature of the impact will comprise the direct requirement for forestry land. The areas of forestry land that will be affected by the Proposed Scheme will be measured and also expressed as a percentage of the total land requirements within the CFA, as shown in Table F.

Table F: Impact magnitude criteria for forestry land

| Impact magnitude | Definitions |
|---|---|
| High | More than 10% of land required for the construction or operation of the Proposed Scheme is forestry land |
| Medium | 6% - 10% of land required for the construction or operation of the Proposed Scheme is forestry land |
| Low | Less than 6% of land required for the construction or operation of the Proposed Scheme is forestry land |
| Negligible | Less than 1% of land required for the construction or operation of the Proposed Scheme is forestry land |

4.2.14 The sensitivity of forestry, as a land use, will be determined within the context of the abundance of forestry land in the locality, as measured within a 4km-wide corridor, following the approach taken with agricultural land. The abundance will be related to the average woodland coverage in England of 10%, as demonstrated in Table G.

Table G: Forestry land sensitivity criteria

| Resources sensitivity | Definition |
|---|---|
| High | Forestry land where there is less than the national average forestry cover (<6%) |
| Medium | Forestry land where there is the national average forestry cover (6-10%) |
| Low | Forestry land where there is above the national average forestry cover (>10%) |

4.2.15 The significance of an effect will be a product of the magnitude of the impact and the sensitivity of the receptor, as summarised in Table C.

*Soil resources*

4.2.16 The impact on the soil resource will reflect the degree to which soil resources are reused on and off the Proposed Scheme in a manner that enables the resource to continue to fulfil one or more of the primary soil functions of:

- the production of food and biomass, and the provision of raw materials;
- the storage, filtration and cycling of water, carbon and nitrogen in the biosphere;
- the support of ecological habitats and biodiversity;
- the support for the landscape;
- the protection of cultural heritage; and
- the provision of a platform for human activities, particularly construction and recreation.

4.2.17 High impacts will occur where the soil displaced from the Proposed Scheme is unable to fulfil one or more of these functions; Medium impacts will occur where these functions are fulfilled primarily off-site due to the displacement of the soil; Low impacts will occur where these functions are fulfilled primarily on-site; and Negligible impacts will occur where the soil retains its pre-existing functions on-site.

4.2.18 The sensitivity of displaced soil will reflect its textural characteristics and its susceptibility to the effects of handling during construction and the re-instatement of

land. Following the soil wetness class assessments set out in the Agricultural Land Classification guidelines:

- high sensitivity soils are those with a high clay and silt fraction (clays, silty clays, sandy clays, heavy silty clay loams and heavy clay loams);
- medium sensitivity soils are silty loams, medium silty clay loams, medium clay loams and sandy clay loams; and
- low sensitivity soils are those with a high sand fraction (sands, loamy sands, sandy loams and sandy silt loams).

4.2.19 The significance of effect will be a product of the magnitude of impact and the sensitivity of the soil resource, following the matrix in Table C.

### Construction effects

4.2.20 Construction effects on agricultural and forestry land and farm and farm-based enterprises will include land requirements; severance of agricultural and forestry land and farm holdings; the loss of, or disruption to, buildings and operational infrastructure such as drainage; and the use of the soil resource displaced by the construction of the Proposed Scheme.

4.2.21 Other construction effects will include the deposition of dust on sensitive crops, land uses or buildings; disruption to drainage, irrigation and water supply systems; unintentional pollution of soil and water courses or bodies (used for crop irrigation or livestock drinking water supplies); spread of injurious weeds to adjacent agricultural land from soil and material stockpiles; and construction noise on farm and farm-based enterprises.

4.2.22 Construction effects will be distinguished between temporary and permanent effects. Temporary construction effects will comprise the land required to construct the Proposed Scheme which will include the land returned to agricultural or forestry use after construction; the temporary severance of land during the construction period; and the effects of disruption, principally from construction noise and dust, on land uses and enterprises.

4.2.23 Permanent construction effects will comprise the net area of agricultural and forestry land required to operate the Proposed Scheme, following the construction period and the restoration of land required temporarily to agricultural and forestry uses; the permanent severance of land; and the permanent loss of or effect on farm infrastructure such as property, buildings and structures, and the consequential effects on land uses and enterprises.

### Operational effects

4.2.24 Operational effects on agricultural and forestry land and farm and farm-based enterprises may include sound emanating from moving trains and warning signals and the propensity of operational land to harbour noxious weeds.

4.2.25 The approach to the assessment of effects of operational sound of the Proposed Scheme on agricultural livestock receptors will be made in liaison with sound, noise and vibration specialists, and will concentrate on sound from operational trains

('passby' sound) rather than construction sound where effects are likely to be temporary and reversible.

4.2.26 In a review of existing research, Hanson (2007)[1] identifies reported effects of noise upon different animals, including interference with communication, masking predation, startle and fright, along with other physiological effects. Hearing acuity differs significantly between species and consequently no uniform frequency weighting has been established to best evaluate response. Consequently, the A-weighted sound pressure continues to be used and Hanson cites a number of studies using various noise sources which suggest that levels of around 100dB are associated with an observable effect for disturbance in domestic and wild birds (effects such as accelerated hatching, nest abandonment and panic responses), domestic animals (reduction in cattle milk production, changes of hormonal composition in swine) and startle or panic effects in terrestrial mammals.

4.2.27 Studies specifically investigating the effects of sound from high speed rail and other rail transport are few but it is important to note that high speed train passbys have a different signature to sound from heavily used highways where the sound levels are more continuous and more likely to result in masking and communication interference effects than startle or panic effects. There are however some similarities between the characteristics of noise arising from high speed rail and sub-sonic low flying aircraft, including rapid onset rates, high maximum sound pressure levels and spectra dominated by low frequencies. It is however acknowledged that high speed train passbys are more regular, fixed in terms of route and more consistent in terms of signature, so that habituation may be more likely to occur than for irregular and less predictable over-flights by aircraft. Hanson (2007)[2] suggests that the sound exposure level (SEL), which accounts for both sound pressure level and duration of the event, is the most useful predictor of responses in both wildlife and domestic animals. SEL can be described as the sum of the sound energy over the duration of an event normalised to a 1 second reference period.

4.2.28 Some of the research studies indicate that some animals habituate to noise after several repetitions of exposure. Previous exposure to noise levels below 100dB served to eliminate panic among turkeys, and swine showed initial alarm followed by indifference to aircraft noise greater than 100dBA.

4.2.29 With regard to the effects of noise on horses, the International League for Protection of Horses issued advice in relation to the Airdrie-Bathgate Railway Improvements Bill which indicated that horses usually became habituated to repeated noise including that from passing trains, although it is acknowledged that there may be a short period of adjustment.

4.2.30 Based on the preliminary indications identified in these studies regarding the most appropriate descriptor, threshold levels for disturbance and habituation characteristics of a small number of species, the US Department of Transportation, Federal Railroad Administration (FRA) has identified interim criteria for identifying the potential impact of high speed rail noise on animals in wilderness and farming areas.

[1] C.E. Hanson (2007), High Speed Train Noise Effects on Wildlife and Domestic Livestock, Notes on Numerical Fluid Mechanics and Multidisciplinary Design Vol 99, 2008, pp26-32.
[2] C.E. Hanson (2007), High Speed Train Noise Effects on Wildlife and Domestic Livestock, Notes on Numerical Fluid Mechanics and Multidisciplinary Design Vol 99, 2008, pp26-32.

4.2.31 The FRA interim criteria (FRA, 2005)[3] have been defined as follows:

- noise metric – A-weighted sound pressure level (dBA);
- noise descriptor – sound exposure level (SEL);
- threshold for impact – 100 dBA; and
- habituation – no general criterion (insufficient information on species specific responses).

4.2.32 It should be noted that these criteria are based on responses observed in birds and mammals only. Criteria are not yet fully developed to the point where dose-response relationships can be fully described for different animal species.

4.2.33 The data from the sound, noise and vibration assessment indicate that the SEL of a train pass-by is unlikely to exceed 100 dB(A) beyond approximately 25m from the track. Consideration of the FRA interim criteria would there suggest that adverse effects on relevant wildlife species or agricultural livestock are less likely to occur beyond this distance.

4.2.34 The FRA interim criterion of SEL 100dB(A) will be used to identify potential significant adverse effects upon agricultural livestock. In the absence of natural or man-made wayside barriers, this would include receptors within a distance of up to 25m from the nearside track for trains travelling at a maximum speed of 360km/h; at lower speeds this distance may be reduced.

4.2.35 However, as it is assumed that grazing livestock will be able to move freely away from the sound source, the assessment will concentrate on identifying fixed livestock buildings or other enclosures close to the track. It is proposed to identify potential receptors within 40m rather than 25m of the track, as livestock buildings within 25m of the nearside track could be demolished as part of the construction works. Once identified, the sound, noise and vibration specialists will advise on the operational sound level at the identified receptor locations given the likely train speeds and known scheme design (including cuttings and other features that would attenuate sound). The significance of effect will be determined in liaison with the sound, noise and vibration specialists.

[3] U.S. Department of Transportation, Federal Railroad Administration (2005), High-Speed Ground Transportation Noise and Vibration Impact Assessment, Office of Railroad Development, (http://www.fra.dot.gov/us/content/253).

# 5 Air quality

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 5.2.5 | Supplementary text provided within SMR Addendum and text within paragraph clarified. |
| 5.5.6 | Paragraph deleted and replacement text provided within SMR Addendum. |
| 5.6.4 | Supplementary text provided within SMR Addendum. |
| Table 1 | Table updated within SMR Addendum. |
| 5.6.16 | Paragraph amended |
| 5.6.20 | Paragraph deleted and replacement text provided within SMR Addendum. |
| **Technical Notes – appended to this document** | |
| Air quality assessment for construction issues | |
| Guidance on assessment methodology | |

## 5.1 Establishment of baseline and definition of survey

5.1.1 *[Paragraph 5.2.5 amended to:]* Further background air pollutant concentration data is available on Defra's Air Information Resource (AIR) website[4]. This data comprise estimated background air pollution data for 2010 and projections for future years for a 1km$^2$ grid for every local authority in the UK.

5.1.2 *[paragraph 5.2.5 supplemented with:]* It is acknowledged that there is considerable uncertainty regarding future pollutant concentrations in the UK. It is expected that pollutant concentrations will reduce as a result of continuing emission controls, although the rate of future decreases is uncertain. In this assessment, the current Government guidance will be followed to predict future pollutant concentrations. The assessment of the significance of air quality impacts will be based on an established method taking into account the predicted changes in concentrations as a result of the Proposed Scheme.

## 5.2 Scope of assessment

### Technical scope

5.2.1 *[paragraph 5.5.6 amended to:]* The assessment will not include the transboundary effects of the Proposed Scheme on air quality, as the likely changes in atmospheric emissions would be negligible in this context.

## 5.3 Assessment methodology

### Significance criteria

5.3.1 [P*aragraph 5.6.4 - the following sentence now added at the end of paragraph:]* Within the CFA reports, the term 'air quality standards' refers to both the English Air Quality Objectives and the Air Quality Limit Values introduced in the UK based on EU Directives.

5.3.2 *[Table 1 of the SMR amended to:]*

[4] Defra; UK-Air; http://uk-air.defra.gov.uk

Table 1: UK and EU air quality standards

| Pollutant | Averaging period | Limit value / objective | Date for compliance | Basis |
|---|---|---|---|---|
| Nitrogen dioxide ($NO_2$) | 1 hour mean | 200µg/$m^3$ not to be exceeded more than 18 times a year (99.8$^{th}$ percentile) | 11 June 2010 | UK[(a)] |
| | | | 1 Jan 2010 | EU[(b)] |
| | Annual mean | 40µg/$m^3$ | 11 June 2010 | UK[(a)] |
| | | | 1 Jan 2015[(1)] | EU[(b)] |
| Particulates ($PM_{10}$) Measurement technique: Gravimetric | Daily mean | 50µg/$m^3$ not to be exceeded more than 35 times a year (90.4$^{th}$ percentile) | 11 June 2010 | UK[(a)] |
| | | | 11 June 2011[(2)] | EU[(b)] |
| | Annual mean | 40µg/$m^3$ | 11 June 2010 | UK[(a)] |
| | | | 1 Jan 2005[(3)] | EU[(b)] |
| Particulates ($PM_{2.5}$) Measurement technique: Gravimetric | Annual mean | 25µg/$m^3$ | 1 Jan 2015 | UK[(a)] |
| | | | | EU[(b)] |
| | | 20µg/$m^3$ | 1 Jan 2020 | EU* |

[(a)] The Air Quality Standards Regulations 2010, SI 2010/1001.
[(b)] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.
[(1)] Extension to the compliance with the annual mean NO2 limit value granted by the European Commission. Sources: C(2011)6208 and C(2012)4155.
[(2)] Extension to the compliance with the daily mean $PM_{10}$ limit value granted by the European Commission. Source: C(2011)1592.
[(3)] Extension to the compliance with the annual mean $PM_{10}$ limit value not granted by the European Commission. Source: C(2009)9588.
*http://ec.europa.eu/environment/air/quality/legislation/time_extensions.htm*
* Indicative until the European Commission's review of air policies.

## Operational Effects

5.3.3 *[Paragraph 5.6.16 amended to:]* With regard to assessment of the effects of emissions arising from changes in traffic flows during construction, traffic data will be screened using the DMRB criteria described in paragraph 5.5.1. Following this screening exercise, roads meeting any of these criteria would be subject to further assessment, including using the air quality screening tool specified in DMRB, as required. This tool can then be used to forecast concentrations of traffic-related pollutants (NO2 and PM10) at receptors. If this predicts significant change in pollutant concentrations, an appropriate atmospheric dispersion model (e.g. ADMS-Roads or ADMSUrban) would be used to further investigate the effects of changes in traffic flow at those receptors. Dispersion modelling would use the latest available vehicle emission data from Defra and take into account information in the National Atmospheric Emission Inventory and the London Atmospheric Emissions Inventory as appropriate. Comparison of results with and without the construction traffic and local diversions in the future years would allow the effect to be determined.

5.3.4 *[Paragraph 5.6.20 amended to:]* Defra has published technical guidance for local authorities on when and how emissions from moving and stationary diesel trains should be considered in relation to Local Air Quality Management duties[5,6]. In the absence of any other specific guidance, this will be used to inform the assessment of potential local air quality impacts from construction related train operations. Defra's guidance addresses locations with relevant public exposure where there is risk of

[5] UK Government; International, European and national standards for air quality; http://www.defra.gov.uk/environment/quality/air/air-quality/laqm/guidance/
[6] Defra; Guidance on Assessing Emissions from Railway Locomotives; http://laqm.defra.gov.uk/laqm-faqs/faq37.html

exceedance of the annual mean air quality standard for NO2. Such locations are within 30m of railway tracks but only where the background annual mean NO2 concentration is above 25µg/m3. In the context of the Proposed Scheme these locations may occur in the vicinity of temporary railheads where diesel locomotives are routinely idling or used for shunting.

# 6 Climate - greenhouse gas emissions

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 6.1.3 | Supplementary text provided within SMR Addendum |
| 6.2.2 | Supplementary text provided within SMR Addendum |
| 6.6.5 | Paragraph deleted and replacement text provided within SMR Addendum |
| 6.6.6 | Paragraph deleted |
| 6.6.7 | Paragraph deleted and replacement text provided within SMR Addendum |
| 6.6.8 | Paragraph deleted |
| 6.6.9 | Text within paragraph clarified within SMR Addendum |

## 6.1 Introduction

6.1.1 *[paragraph 6.1.3 amended to:]* Assessments will be carried out for the following time periods:

- 2017 – start of construction;
- 2026 - Proposed Scheme opening;
- 2036- once maximum timetable is in operation; and
- 2086 – 60 years of operation after opening.

## 6.2 Establishment of baseline and definition of survey

6.2.1 *[paragraph 6.2.2 amended to:]* Scenarios of current and future baselines will be built on the work of the Appraisal of Sustainability (AoS)[7]. The baseline greenhouse gas (GHG) assessment will cover the following aspects:

- changing travel patterns and modal shift;
- surface access to existing stations;
- projected UK grid power emissions (for example nuclear versus coal based projection); and
- planned associated developments (such as roads and depots).

## 6.3 Assessment methodology

6.3.1 *[Paragraph 6.6.5 amended to:]* Construction related emissions will be based on the engineering team's Construction and Logistics reports for the Proposed Scheme These reports include information relating to specific design element (such as viaducts or bridges) across the entire route in terms of:

- volume ($m^3$) of construction materials;
- type of construction material (e.g. concrete, imported fill, steel, gravel etc.);

[7] Booz and Co. Ltd/Temple Group Ltd (2011), HS2 London to the West Midlands Appraisal of Sustainability.

- transport distances (km) of construction material; and
- volume ($m^3$) of waste generated (both construction and demolition).

6.3.2 *[Paragraph 6.6.7 amended to:]* Construction site emissions relating to fuel and energy use by plant equipment will be calculated using Arup's CO2ST tool. The tool considers carbon associated with machinery and plant used as well as travel from construction workers. The background library of information which the CO2ST tool is based on includes The Reference Manual for Construction Plant[8] and Defra's carbon coefficients.

6.3.3 *[paragraph 6.6.9 amended to:]* Transport related emissions will be based on the PLANET Framework Model (PFM[9]) outputs. Outputs from the transport modelling requested for the GHG assessment include:

- Surface access: travel to and from each station by modal split, number of trips and average trip distance;
- Classic rail network: change in train movements on the classic network as a result of uptake of services on the Proposed Scheme. If modelling outputs permit, an analysis of the released capacity on the classic network for passenger or freight transport (outputs to be confirmed with transport modellers) will be undertaken;
- Modal shift: transfers from air to rail for domestic trips between London and Manchester/ Birmingham/ Glasgow and Leeds. Although there are no flights between London and Birmingham (the route of the Proposed Scheme), there are flights to Manchester, Leeds and other destinations further north. Phase 2 will indirectly impact the modal shift (road and rail) on the Proposed Scheme through, for example, planned increase in services on the London to Birmingham section). This impact of Phase 2 on the Proposed Scheme will be considered in the assessment;
- Modal shift: transfer from road onto the Proposed Scheme (i.e. between London and Birmingham); and
- Construction transport: transport movements associated with construction activities such as movement of spoil and access to site; and
- Personal transport: any additional transport on existing routes caused by disruption associated with the Proposed Scheme in terms of construction activities and operation.

[8] Institution of Civil Engineering Surveyors (2003), The Reference Manual for Construction Plant.
[9] PLANET is a multimodal transport model which estimates the numbers of passengers that will use the Proposed Scheme.

# 6(A). Climate change adaptation

Note – Section 6 of the SMR largely discussed the effects of the Proposed Scheme on climate with reference to greenhouse gases (GHG), with climate change adaptation (CCA) discussed within individual topic areas, where relevant. For ease of reference the scope and methodology for CCA will now be grouped together, and is presented below as a new addition to the SMR.

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| N/A – new section not previously within SMR | Supplementary text provided within SMR Addendum. |

## 6.1 Establishment of baseline and definition of survey

6.1.1 A climate change impacts assessment, which will include consideration of the combined impacts of the Proposed Scheme and potential climate change on the receiving environment and community, will be undertaken.

### Climate change projections

6.1.2 At present, no legislation exists that specifies which climate change projections and scenarios are to be used as part of a climate change impacts assessment within the UK Environmental Impact Assessment (EIA) process. Given this, the methodology for the consideration of potential climate change impacts within the EIA draws upon the following sources:

- trends derived from UKCP09 projection data[10], which reflect scientists' best understanding of how the climate system operates and how it might change in the future;
- European Union guidance[11] on integrating climate change and biodiversity into Environmental Impact Assessment (EIA);
- Institute of Environmental Management and Assessment (IEMA)[12];
- European Bank of Reconstruction and Development (EBRD)[13]; and
- relevant reports from Reporting Authorities submitted under the UK Adaptation Reporting Power[14] (for example Network Rail, National Grid, Highways Agency and Transport for London).

6.1.3 The consideration of the potential additional impacts of climate change on the effects associated with the Proposed Scheme will be based upon the most recent, publically available research and evidence. However, climate change science is an evolving field of enquiry, and the integration of potential climate change impacts into the EIA process is a relatively new approach. For some topics the evidence base is not definitive, or there is insufficiently detailed evidence available at the local level, which

[10] UKCP09 (2009) Climate Change Projections Report. [online] http://ukclimateprojections.defra.gov.uk/22566. Accessed July 2013.
[11] http://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf.
[12] IEMA; EIA & Climate Change; http://www.iema.net/eia-climate-change.
[13] European Bank for Reconstruction and Development; Sustainability Report 2011; http://www.ebrd.com/pages/digital-publications/flagships/sr11/climate-change-and-energy/integrating-climate-change-adaptation-into-projects.html.
[14] Defra; http://www.defra.gov.uk/environment/climate/sectors/reporting-authorities/reporting-authorities-reports/.

means it may be difficult to draw conclusions about the potential impacts of climate change in line with the established EIA methodologies for each topic.

6.1.4 Therefore, following consideration of potential climate change impacts, informed professional judgement will be used by topic experts to produce high level, qualitative statements about potential topic specific impacts resulting from projected changes and trends for climate averages and extreme weather events, along with consideration of any potential additional topic specific mitigation measures required.

6.1.5 A notable exception is the assessment of flood risk, which will be undertaken using climate change projections as specified in the National Planning Policy Framework (NPPF)[15]. The flood risk assessment will use the recommended precautionary sensitivity ranges of key parameters as given in Table 5 in the Technical Guidance to the NPPF. Sensitivity testing to be undertaken will allow for variations in climate change factors included in other national guidance.

6.1.6 The consideration of potential climate change impacts on the effects associated with the Proposed Scheme will be undertaken in accordance with timeframes outlined in the methodologies for each topic. Table H provides a comparison of these timeframes and the corresponding timeframes for UK climate change projections.

Table H: Temporal scope for consideration of climate change impacts

| | **Construction** | **Operation (start)** | **Operation (peak)** |
|---|---|---|---|
| Topic assessment timeframe | 2017-2026 | 2026 onwards | 2041 |
| Corresponding UKCP09 timeframe | 'the 2020s' (2010-2039) | 'the 2020s' (2010-2039) | 'the 2050s' (2040-2069) |

6.1.7 During the construction phase of the Proposed Scheme (2017 – 2026), the trends within the UKCP09[16] climate change projections suggest the following changes to long-term, seasonal averages:

- warmer, drier summers, particularly in parts of southern England[17];
- milder, wetter winters, particularly in the western side of the UK[18];
- an increase in annual average temperature[19i] and
- fewer days with snow and frost[20].

6.1.8 Extreme weather during the construction phase will:

- very likely include more very hot days[21];
- likely include more intense downpours of rain[22] (particularly in summer); and
- very likely include an increase in dry spells[23].

[15] Communities and Local Government; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf .
[16] UK Climate Impacts Programme (UKCIP) (2009), *Climate Change Projections.*
[17] UKCIP (2009), Climate Change Projections, Table 4.1, 4.2, 4.4 and 4.5.
[18] Table 4.1, 4.2, 4.4 and 4.5, *Climate Change Projections*, UKCIP (2009).
[19] UKCIP (2009), Climate Change Projections, Section 4.3.5.
[20] UKCIP (2009), Climate Change Projections, Table 3. UKCIP (2009), Climate Change Briefing Report, Figure 4.31.
[21] UKCIP (2009), Climate Change Briefing Report, Table 3.
[22] UKCIP (2009), Climate Change Projections, Table 4.2.
[23] UKCIP (2009), Climate Change Briefing Report, Table 4.

6.1.9 In addition, it is likely, although with a higher level of uncertainty, that the probability of the following extreme weather events will be increased as a consequence of climate change[24]:

- short periods of intense cold weather (still expected as a result of natural variability[25]); and
- an increase in the frequency of storms and high winds (widely accepted as difficult to predict with any certainty[26]).

6.1.10 During the operation of the Proposed Scheme (2026 onwards), these changes in climatic averages and extreme weather events are projected to become more pronounced.

## 6.2 Scope of assessment

### Spatial scope

6.2.1 Potential climate change impacts will be considered at a spatial scope appropriate to each topic as described in their respective scope and methodology sections.In terms of reporting the results of the assessment,Water Resources and Flood Risk will report at the local level ( in Volume 2) to determine if there are any receptors that are particularly sensitive to potential climate change impacts. Other topics will report their findings in Volume 1, as appropriate.

### Temporal scope

6.2.2 Most topics will consider potential climate change impacts during construction (which includes the reinstatement of landforms and soils, and the commencement of a five-year aftercare period), which is estimated to commence in 2017. Those topics considering potential climate change impacts associated with operation will include 2026 (to reflect the first year of operation) in addition to 2041 (considered to represent peak operation).

6.2.3 TableI contains a summary of each topic's respective choice of temporal scope for their overall impact assessment. The relevant sections of the SMR and SMR Addendum for each topic contain further information regarding their respective temporal scopes, which will be used to inform the consideration of potential climate change impacts within the future baseline.

Table I: Topic specific temporal scope

| EIA topics | Temporal scope |
|---|---|
| Agriculture, forestry and soils | 2017, 2026 and 2041 |
| Air quality | 2017, 2026 |
| Community | 2017 and 2026 |
| Cultural heritage | 2017 and 2026 |
| Ecology | 2017 to 2025, 2026 and 2041 |
| Electromagnetic interference | - |

[24] Scaife, A (2012), Climate Jigsaw Puzzle, Met Office, Available at: http://www.metoffice.gov.uk/barometer/science/2012-04/climate-jigsaw-puzzle
[25] UKCIP (2009), Climate Change Briefing Report, Table 3.
[26] UKCIP (2009), Climate Change Projections, Section 1.4.

| EIA topics | Temporal scope |
|---|---|
| Land quality | 2017 and 2026 |
| Landscape and visual assessment | 2017, 2026, 2041 and 2086 |
| Socio-economic | 2017 and 2026 |
| Sound, noise and vibration | 2017, 2026 and 2041 |
| Traffic and transport | 2012, 2021 2026 and 2041 |
| Waste and material resources | 2017 to 2025 and 2026 |
| Water resources and flood risk | 2017, 2026, 2041 and 2115 (for flood risk only) |

6.2.4 Some topics will not extend their overall assessments of effects associated with the Proposed Scheme through to 2041. Therefore, consideration of potential climate change impacts will relate to the construction phase only. These topics are:

- Air quality;
- Community;
- Cultural heritage;
- Electromagnetic interference;
- Socio-economic; and
- Waste.

6.2.5 This means that potential climate change impacts for these topics will only be considered for the 2020s and not the 2050s.

## Technical scope

6.2.6 The potential significance of climate change impacts is greater for some topics than others due to the varying sensitivity of topic specific receptors and resources to projected changes and trends for climate variables.

6.2.7 The potential significance of climate change impacts for each of the EIA topics is contained in Table J.

Table J: EIA topics and potential significance of climate change impacts

| **Agriculture, forestry and soils**** | | **Land quality*** |
|---|---|---|
| Air quality* | | Landscape and visual assessment** |
| Community** | | Sound, noise and vibration* |
| Cultural heritage* | | Socio-economic* |
| Ecology** | | Traffic and transport* |
| Electromagnetic interference | | Waste and material resources* |
| Water resources and flood risk** | | |

Key:

| | |
|---|---|
| ** | Topics for which climate change impacts were considered to have the greatest potential direct significance |
| * | Topics for which climate change impacts were considered to have less direct potential significance. |
| No asterisk | Topics for which there was not considered to be any significant direct potential climate change impact. |

## 6.3 Assessment methodology

### Overview

6.3.1 All EIA Topics will undertake a preliminary consideration of potential climate change impacts to determine the requirement for, or feasibility of, undertaking a further, more detailed assessment.

6.3.2 This will involve the following steps and will be based upon the professional judgement of the EIA topic specialists working with the climate change adaptation topic specialists:

1. consideration of all impacts associated with the Proposed Scheme already assessed in the Draft Environmental Statement[27] for each topic and the associated mitigation measures for significant impacts;
2. consideration of those assessed impacts which could potentially be affected by climate change; and
3. consideration of whether the potential change in any of these assessed impacts as a result of climate change is likely to be significant and, as a consequence, identification of mitigation measures which enhance climate change resilience.

6.3.3 The results of this preliminary consideration for all topics are included in Volume 5: Appendix CT-009-000.

### Legislation and guidance

6.3.4 Relevant European, national and local policies and guidance on climate change impacts, risks and adaptation (where they exist) are to be identified and referenced for each topic, where relevant.

### Significance criteria

6.3.5 The significance of potential climate change impacts will be assessed qualitatively, based upon the professional judgement of topic specialists working with the climate change adaptation topic specialists.

### Construction effects

6.3.6 The effects of the Proposed Scheme will be assessed for the construction phase, including consideration of the potential additional impacts of climate change if required and/or feasible.

### Operational effects

6.3.7 The effects of the Proposed Scheme will be assessed for the operational phase, including consideration of the potential additional impacts of climate change if required and/or feasible.

[27] HS2 (2013), Draft Environmental Statement, London – West Midlands.

## Mitigation measures

6.3.8 If any of the impacts associated with the Proposed Scheme are considered to be significantly affected by potential climate change impacts, then enhanced or additional mitigation measures (i.e. management measures that reduce the impact of the Proposed Scheme on the environment/and or community - rather than those to reduce greenhouse gas emissions) will be developed by topic specialists.

6.3.9 Recommended additional mitigation measures will be designed so that the measures themselves are resilient to potential additional climate change impacts.

# 7 Community

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 7.1.9 | Paragraph deleted and replacement text provided within the SMR Addendum. |
| 7.4.1 | Paragraph deleted and replacement text provided within the SMR Addendum. |
| 7.5.2 | 2nd row in Table 7 deleted. |
| 7.5.2 | 4th row in Table 7 text amended from 'severance' to 'isolation'. |
| 7.5.2 | 6th row in Table 7 deleted |
| 7.5.2 | 9th row in Table 7 text amended from 'severance' to 'isolation'. |
| 7.5.2 | Rows ten – thirteen in Table 7 deleted. |
| **Technical Notes – appended to this document** | |
| Community and Socio-economics Technical Note - Further Assessment Guidance | |

## 7.1 Introduction

### Community infrastructure/organisations

7.1.1 *[Paragraph 7.1.9 amended to:]* The community assessment recognises the inter-relationship of community and economic effects. As well as covering direct community effects, it takes into account how economic and development impacts and effects identified by the socio-economic assessment will indirectly effect communities (the socio-economic assessment being focused on economic rather than social impacts and effects).

## 7.2 Scope of assessment

### Spatial scope

7.2.1 *[Paragraph 7.4.1 amended to:]* The assessment of community effects will consider impacts and effects during both construction and operation of the Proposed Scheme. Impacts can generate the following broadly defined effects on receptors and resources:

- Loss or gain: A loss or gain to a resource or receptor. For example, a decrease in housing stock as a result of demolitions;
- Displacement: The re-location of receptors and resources from one location to another within the study area. For example, people moved from their homes to replacement homes permanently or temporarily;
- Change in amenity: The benefits of enjoyment and wellbeing that receptors gain from a resource in line with its intended function is referred to as an amenity value. The amenity value that receptors give to resources may be effected by a combination of factors such as: noise and vibration; air pollution/odours; traffic/congestion; air and water quality; and visual impacts. As such, the amenity assessment will draw on the conclusions from other assessment topics which could lead to impacts on communities; and

- Isolation: In the context of this assessment isolation is to be measured by the barriers local communities face in making their usual journeys. This includes physical, psychological and social barriers (i.e. non-economic) and the effects of this on local communities. Isolation of commercial and industrial buildings and land, and agricultural property and land, are addressed within the scope of assessments presented in Section 13 (Socio-economics) and Section 4 (Agriculture, Forestry and Soils).

# 8 Cultural heritage

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| Throughout | Erratum replace undesignated asset with non-designated asset - undesignated is not the correct term, the NPPF uses the phrase non-designated. |
| 8.2.10 | Revision to paragraph, Text within paragraph clarified within SMR Addendum |
| 8.2.15 | Text deleted 'ZTV' and replaced with 'study area' |
| 8.2.16 | Paragraph deleted |
| 8.2.20 | Text deleted 'ZTV' and replaced with 'study area' |
| 8.2.21 | Paragraph deleted |
| 8.5.7 | Text deleted 'as defined by the ZTV' |
| **Technical Notes – appended to this document** | |
| Risk based approach to archaeological assessment | |
| Fieldwalking | |
| Geophysical survey | |

## 8.1 Establishment of baseline and definition of survey

8.1.1 *[paragraph 8.2.10 amended to:]* The definition of the study area for heritage assets will vary between the metropolitan urban and country sections of the Proposed Scheme. The study area in urban London and Birmingham will comprise the entire loss of land required for construction (including permanent and temporary works), plus 250m either side of the full extent of the required land. In rural sections, the study area will encompass the entire land required for the construction of the Proposed Scheme plus 500m either side of the full extent of the land required. In addition for the appraisal of the setting of designated heritage assets, including historic landscapes, the study area will be defined by an area of up 2km from the centre line of the Proposed Scheme for both rural and urban sections of the route. In urban sections of the route a degree of professional judgement will be required in order to determine an appropriate extent for the study area within which designated assets are to be assessed so as to ensure that the assessment remains proportionate. The setting of designated assets within the study area will be cross-referenced to the zone of theoretical visibility (ZTV) as this becomes available. The extent of the ZTV will be identified by the Landscape, and Visual Assessment within the ES.

# 9 Ecology

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 9.2 | Supplementary text provided within SMR Addendum |
| 9.5 | Supplementary text provided within SMR Addendum after 9.5.4 |
| 9.5 | Supplementary text provided within SMR Addendum after 9.5.7 |
| 9.6.1 | Paragraph deleted and replacement text provided within SMR Addendum |
| 9.6.2 | Supplementary text provided within SMR Addendum |
| 9.6.5 - 9.6.8 | Paragraphs deleted within SMR Addendum and replacement text provided within SMR Addendum, with further detail in the Ecological Assessment Method Technical Note |
| 9.6.9 | Paragraph deleted and replacement text provided within SMR Addendum |
| 9.7.1 | Paragraph deleted |
| **Technical Notes – appended to this document** | |
| Field survey methods and standards | |
| Ecological assessment method | |
| Methodology for demonstrating no net loss in biodiversity | |
| Ecological principles of mitigation | |

## 9.1 Establishment of baseline and definition of survey

9.1.1 *[Section 9.2 supplemented with:]* As a general rule desk study records dated prior to 1 October 1997 will be considered as historic and unlikely to provide relevant information to inform the baseline for the assessment. Different cut-off dates will be applied for the following receptors:

- habitats and higher/lower plant records - all records prior to 1 October 1986 considered as historic (a longer period than the standard due to their less mobile nature); and
- white-clawed crayfish - all records prior to 1 October 2002 considered as historic (a shorter period than the standard due to the on-going rapid decline in numbers resulting from the spread of non-native crayfish).

9.1.2 Data from prior to the above dates will only be included in the ES where no more recent survey data are available, or where the data are of contextual value in relation to considering evidence of longer term species declines/advances and/or to identifying potential targets for habitat creation or species re-introductions.

9.1.3 Survey methodologies and basic extents for common ecological surveys required on a widespread basis across the route are provided in the Ecological surveys: field survey methods and standards (FSMS) technical not within Annex D of this SMR Addendum. The methods incorporate feedback from engagement with Natural England and the Environment Agency.

9.1.4 The FSMS Technical Note is not intended to cover all survey methodologies utilised. Where specific locations will require the use of additional survey methods or deviations from the methodologies identified in the FSMS these are to be reported within the relevant Community Forum Area (CFA) reports within the ES.

## 9.2 Scope of assessment

### Geographic scope

9.2.1 *[Additional Text inserted after 9.5.4:]* Due to the large scale of the scheme and the large volumes of information to be collected in support of the assessment, The ES will report on only those resources/receptors identified as potentially relevant to the assessment. This has been defined as follows:

- all statutory designated sites located within a 500m radius of the land required for the construction of the Proposed Scheme, and any others considered potentially subject to significant effects; and
- non-statutory designated sites, protected and/or notable habitats and species within or adjacent to land required for the construction of the Proposed Scheme, and any others considered potentially subject to significant effects.

### Technical scope

9.2.2 [*Additional text inserted after 9.5.7*:] In order to ensure that all likely significant effects of the Proposed Scheme will be identified, where baseline information is incomplete a precautionary approach of assuming a 'reasonable worst-case' valuation is to be adopted. This approach will be utilised to assign precautionary values to both known receptors and potential receptors based on the best available information. Further details are provided in the Ecological assessment method technical note, see Annex D of the SMR Addendum .

9.2.3 In line with Government policy, HS2 Ltd is seeking to ensure that the Proposed Scheme results in no net loss in biodiversity. A modified version of the Defra offsetting pilot methodology[28] will be utilised to compare the habitats present pre- and post-construction, and inform the level of compensation provision required to achieve this goal. Biodiversity offsetting will not form part of the EIA to be reported in the ES and the commitment to no net loss does not form part of the requirements under the EIA Regulations.

9.2.4 Consideration of the Proposed Scheme's compliance with Water Framework Directive objectives will be presented in a stand-alone document within the ES.

9.2.5 The potential impacts and effects of climate change on ecological receptors, alongside the effects of HS2 on the ability of habitats and species in the wider landscape to respond to climate change will be considered, primarily as part of the route-wide assessment in Volume 3 of the ES.

## 9.3 Assessment methodology

9.3.1 *[Paragraph 9.6.1 amended to]* The assessment is to be guided by the methodology advocated by the Institute of Ecology and Environmental Management (IEEM). Full details of the assessment methodology are provided in the Ecological assessment method technical note in Annex D of the SMR Addendum.

[28] Defra (2012), *Biodiversity Offsetting Pilots – The metric for the biodiversity offsetting pilot in England*, Defra.

## Legislation

9.3.2 *[Paragraph 9.6.2 supplemented with:]*

- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 [29] ; and
- Salmon and Freshwater Fisheries Act, 1975 (as amended).[30]

## Significance criteria

9.3.3 *[Paragraphs 9.6.5 to 9.6.8 deleted and replaced by*:] Further details of the significance criteria used for the assessment are provided within the Ecological assessment method technical note in Annex D of the SMR Addendum.

9.3.4 *[Paragraph 9.6.9 amended to:]* Each potential ecological receptor will be evaluated against the following geographical frames of reference: international; national; regional; county/metropolitan; district/borough; local/parish; and negligible. The standard geographical frames of reference of 'site' and 'within zone of influence' will not be utilised as they are not considered appropriate for a linear scheme of this scale.

## Determining the significance of effects

9.3.5 *[Section 9.6 supplemented with:]* Details of the process for determining significance of effects is provided within ecological assessment method technical note.

[29] HM Government (2003), *Statutory Instrument 2003 No. 3242 The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003*, The Stationery Office.
[30] HM Government (1975) *Salmon and Freshwater Fisheries Act, 1975*, Chapter 51. Her Majesty's Stationery Office.

# 10 Electromagnetic interference

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 10.1.1 | Paragraph deleted and replacement text provided within SMR Addendum |
| 10.1.4 | Paragraph deleted and replacement text provided within SMR Addendum |
| 10.1.6 | Paragraph deleted and replacement text provided within SMR Addendum |
| 10.1.7 Footnote | Text deleted and replacement text provided within SMR Addendum |
| 10.2.4 | Text deleted and replacement text provided within SMR Addendum |
| 10.2.6 | Text deleted and replacement text provided within SMR Addendum |
| 'consultation as part of the EIA process' | Heading deleted (above paragraph 10.3.2) |
| 10.3.2 | Paragraph deleted |
| 10.4.2 | Text deleted and replacement text provided within SMR Addendum |
| 10.5.1 | Text deleted and replacement text provided within SMR Addendum |
| 10.5.2 | Text deleted and replacement text provided within SMR Addendum |
| 10.5.4 | Text deleted and replacement text provided within SMR Addendum |
| 10.5.5 | Text deleted and replacement text provided within SMR Addendum |
| 10.6.1 | Text deleted and replacement text provided within SMR Addendum |
| 'EMC Zones' | Heading deleted (above paragraph 10.6.2) |
| 10.6.2 | Text deleted and replacement text provided within SMR Addendum |
| 10.6.3 | Text deleted and replacement text provided within SMR Addendum |
| 10.6.4 | Text deleted and replacement text provided within SMR Addendum |
| 10.6.5 | Paragraph deleted |
| 10.6.6 | Paragraph deleted |
| 10.6.7 | Paragraph deleted |
| 10.6.8 | Text deleted and replacement text provided within SMR Addendum |
| 10.6.9 | Paragraph deleted |
| 10.6.10 | Text deleted and replacement text provided within SMR Addendum |
| 10.6.11 | Text deleted and replacement text provided within SMR Addendum |
| 10.6.12 | Text deleted and replacement text provided within SMR Addendum |
| 10.6.13 | Text deleted and replacement text provided within SMR Addendum |
| **Technical Notes – appended to this document** | |
| Electromagnetic interference | |

10.1.1 The majority of the amendments to the SMR for Electromagnetic Interference (EMI) reflect the change in emphasis from Electromagnetic Compatibility (EMC), which is the method of mitigating against electrical interference, to the assessment of the effects of electromagnetic fields (EMF) (which cause EMI and potential human health problems).

## 10.2 Introduction

10.2.1 *[Paragraph 10.1.1 amended to:]* This section of the Report covers the impacts and effects of the Proposed Scheme on Electromagnetic Fields (EMF), and

Electromagnetic Interference (EMI), including Electro Magnetic Compatibility (EMC). EMF is produced whenever electricity is present.

10.2.2 *[Paragraph 10.1.4 amended to:]* The principal source of EMF from the Proposed Scheme that may have an effect on third parties will be the traction power supply system. Emissions from the signalling and communication systems, electrical and mechanical systems, generally only affect the internal railway operating system. In addition, equipment located within the infrastructure maintenance depot and the stations/interchanges such as lifts and escalators and other large items of plant, do not produce levels of EMF that will have an effect outside of the operational railway.

10.2.3 *[Paragraph 10.1.6 amended to:]* EMI is an issue that can normally be mitigated though the application of EMC industry accepted practice during design and installation.

10.2.4 *[10.1.7 Footnote amended to:]* [89] ICNIRP (2010) 'Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (1Hz to 100kHz)', Health Physics, 99 (6): pp. 818-836

## 10.3 Establishment of baseline and definition of survey

10.3.1 *[Paragraph 10.2.4 amended to:]* British and European Standards exist to mitigate the effects of EMI on neighbouring railways, which will be adopted through design, installation, operation and maintenance best practice. HS2 Ltd will consult with other infrastructure owners during the design period.

10.3.2 *[Paragraph 10.2.6 amended to:]* EMI from the Proposed Scheme's rolling stock will only affect the operational railway.

10.3.3 *[Supplementary text provided after 10.2.6:]* A desk top assessment will be undertaken to identify potential receptors at risk. Examples of potential sensitive sites that may be at risk and are to be considered are:

- universities;
- schools;
- hospitals;
- military establishments;
- airports;
- emergency and commercial radio stations;
- residential properties; and
- industrial properties.

## 10.4 Key aspects of the Proposed Scheme for the topic

10.4.1 *[Paragraph 10.4.2 amended to:]* The main source of EMF will be the traction power system, as electromagnetic emissions are caused by the current flowing in an electrical system.

10.4.2 The higher currents found in high voltage power lines have the potential to create larger EMF, the strength of which diminish rapidly with distance from the source.

## 10.5 Scope of assessment

10.5.1 *[Paragraph 10.5.1 amended to:]* A desk study will be undertaken to identify potential sources of EMF and EMI that may be produced during both the construction and operational phases of the Proposed Scheme. This will identify the potential risk and the potential impact and effect. The desk-based study will also identify establishments where people are potentially at risk from the electromagnetic fields produced by the Proposed Scheme's 25 kilovolts (kV) electrification traction power.

10.5.2 *[Paragraph 10.5.2 amended to:]* The study will identify potentially sensitive receptor sites within a 50m corridor either side of the centreline of the nearest track within the Proposed Scheme, or from proposed power equipment (e.g. overhead lines and traction substations)

10.5.3 *[Paragraph 10.5.4 amended to:]* A risk assessment will be undertaken to assess the impact of EMF effects on nearby equipment, installations and people.

10.5.4 *[Paragraph 10.5.5 amended to:]* The assessment will use data from the preliminary traction power modelling completed by HS2, in undertaking the evaluation.

## 10.6 Assessment methodology

10.6.1 *[Paragraph 10.6.1 amended to:]* The following standards are relevant:

- ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (1Hz to 100kHz 2010;
- The Electromagnetic Compatibility Directive 2004/108/EC;
- BS EN 61000-6-1:2007. Electromagnetic compatibility Part 6.1: Generic standards- immunity for residential, commercial and light industrial environments;
- BS EN 61000-6-2:2005. Electromagnetic compatibility Part 6.2: Generic standards- immunity for industrial environments;
- BS EN 50499:2008. Procedure for the assessment of the exposure of workers to electromagnetic fields;
- EC Recommendation 1999/519/EC on the limitation of exposure of the general public to electromagnetic fields (0Hz to 300GHz);
- EU Directive 2006/42/EC on machinery;
- BS EN 50121 series of standards, Railway Applications, Electromagnetic Compatibility, which contains the following parts;
  - BS EN 50121-1:2006 Part 1: General;
  - BS EN 50121-2:2006 Part 2: Emissions of the whole railway system to the outside world;

- BS EN 50121-3-1:2006 Part 3-1: Rolling stock - train and complete vehicle;
- BS EN 50121-3-2:2006 Part 3-2: Rolling stock – apparatus;
- BS EN 50121-4:2006 Part 4: Emissions and immunity of the signalling and telecommunications apparatus;
- BS EN 50121-5:2006 Part 5: Emissions and immunity of fixed power supply installations and apparatus.

- BS EN 50122 series of standards, Railway Applications - Fixed installations - Electrical safety, earthing and the return circuit, which consists of;
  - BS EN 50122-1:2011 Part 1: Protective provisions against electric shock;
  - BS EN 50122-2:2010 Part 2: Provisions against the effects of stray currents caused by d.c. traction systems;
  - BS EN 50122-3:2010 Part 3: Mutual Interaction of a.c. and d.c. traction systems.

10.6.2 *[Paragraph 10.6.2 amended to:]* Using the estimated levels of generated EMF from the preliminary traction power modelling results, the levels of predicted EMF will be assessed against the maximum levels mandated by British and European Standards and ICNIRP.

10.6.3 *[Paragraph 10.6.3 amended to:]* For the effects of EMF on human health, any level above 200 microTesla (μT) stated within ICNIRP will be considered as significant.

10.6.4 *[Paragraph 10.6.4 amended to:]* For the effects of EMI on susceptible electrical or electronic equipment, where the level exceeds 3 Amperes per metre (A/m) for residential and 30A/m for industrial equipment, this will be regarded as significant. These levels are the current limits identified in BS EN 61000-6-1 and BS EN 61000-6-2 respectively.

10.6.5 *[Paragraph 10.6.8 amended to:]* Where risk is identified, proposals for mitigation will be recommended.

10.6.6 *[Paragraph 10.6.10 amended to:]* The effects of construction will be evaluated and mitigation measures implemented if required. Ongoing measurements and monitoring will be considered during construction, where significant risks are identified.

10.6.7 *[Paragraph 10.6.11 amended to:]* The effects of operation will be evaluated and mitigation measures implemented if required.

10.6.8 *[Paragraph 10.6.12 amended to:]* Any cumulative effect due to the Proposed Scheme running close to an existing electrified railway, for example, will be included in the assessment

10.6.9 *[Paragraph 10.6.13 amended to:]* The traction power modelling, the results from which the assessment will be made, will be developed using the worst case traction loads for the proposed timetable. Any effects of EMF and EMI will therefore be considered using the worst case loads.

# 11 Land quality

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 11.2 | Supplementary text provided within SMR Addendum |
| 11.2.3 | Text deleted and replacement text provided within SMR Addendum |
| 11.4.5 | Text 'Mining issues.....areas in the Midlands' deleted. |
| 11.6.8 | Text within paragraph clarified within SMR Addendum |
| Table 15 | Text within table clarified within SMR Addendum |
| 11.6.13 | Text within paragraph clarified within SMR Addendum |
| Table 16 | Text within table clarified within SMR Addendum |
| **Technical Notes – appended to this document** | |
| Introduction to land quality assessments | |
| Detailed methodology for land contamination assessments | |
| Methodology and significance criteria for geological issues (excluding land contamination) | |
| Operational issues | |
| Potential mitigation measures | |

## 11.1 Establishment of baseline and definition of survey

11.1.1 *[Section 11.2 supplemented with:]* The technical note 'Introduction to land quality assessments' gives more details of the sources and types of information to be collected – refer to Annex F of the SMR Addendum.

11.1.2 *[Section 11.2 supplemented with:]* The issue of the effects of underground mining on the construction of the Proposed Scheme will not be assessed during the environmental assessment. It is however being considered as part of the engineering design of the route.

11.1.3 *[Paragraph 11.2.3 amended to:]* Documentary data are available from a number of Governmental and non-governmental organisations including:

- Environment Agency;
- British Geological Survey; and
- county councils and district councils.

## 11.2 Assessment methodology

### Significance criteria

11.2.1 *[Paragraph 11.6.8 and Table 15 clarified with:]* Impact magnitude criteria are presented separately for contaminated land, mining/mineral issues and for geo-conservation resources. These are provided in the technical notes - 'Detailed methodology for land contamination assessments' and 'Methodology and significance criteria for geological issues (excluding land contamination)' in Annex F of this SMR Addendum.

11.2.2 *[Paragraph 11.6.13 and Table 16 clarified with:]* Significance of effects criteria are presented separately for contaminated land, mining/mineral issues and for geo-

conservation resources. These are provided in - 'Detailed methodology for land contamination assessments' and 'Methodology and significance criteria for geological issues (excluding land contamination)' in Annex F of the SMR Addendum.

11.2.3 *[Section 11.6 supplemented with:]* A screening system will be utilised to identify sites which may pose a contaminative risk for the Proposed Scheme, and a revised methodology developed to determine the significance of such sites in the context of the construction of the Proposed Scheme. Further details on the developed methodology are contained within 'Detailed methodology for land contamination assessments' in Annex F of the SMR Addendum.

# 12 Landscape and visual assessment

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 12.1.1 | Supplementary text provided within SMR Addendum. |
| 12.1.3 | Paragraph deleted and replacement text provided within SMR Addendum. |
| 12.2.4 | Paragraph deleted and replacement text provided within SMR Addendum. |
| 12.2.7 | Supplementary text provided within SMR Addendum |
| 12.2.12 | Supplementary text provided within SMR Addendum. |
| Table 19 | Table deleted and replacement provided within SMR Addendum. |
| 12.5.3 | Supplementary text provided within SMR Addendum. |
| 12.5.5 | Supplementary text provided within SMR Addendum. |
| 12.6.12 | Supplementary text provided within SMR Addendum. |
| 12.7.2 | Paragraph deleted and replacement text provided within SMR Addendum. |
| Table 20 | Table deleted and replacement provided within SMR Addendum |
| Table 22 | Table deleted and replacement provided within SMR Addendum. |
| **Technical Notes – appended to this document** | |
| Approach to tranquillity assessment | |
| Zone of theoretical visibility production methodology | |
| Approach to verifiable photomontages | |

## 12.1 Introduction

12.1.1 *[Paragraph 12.1.1 supplemented with:]* The definition of landscape is 'an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors' (European Landscape Convention – Council of Europe[31], 2000).

12.1.2 *[Paragraph 12.1.3 replaced with:]* For this assessment, the term 'landscape' encompasses all types and forms of open space and development in the countryside, villages, towns and cities. This is to avoid the use of interchangeable terms (such as townscape) which may cause confusion, therefore the term 'landscape' has been consistently used throughout.

## 12.2 Establishment of baseline and definition of survey

12.2.1 *[Paragraph 12.2.4 amended to:]* The landscape and visual surveys will be carried out by Chartered Landscape Architects experienced in EIA. Assessments made will be verified by at least two other Chartered Landscaped Architects experienced in EIA. Survey work will be carried out in both the summer and winter, in order for seasonal change to be considered in the assessment. The survey work will be undertaken in a methodical order as follows:

- verification of the zone of theoretical visibility (ZTV) i.e. the study area [see Section 12.5 (Scope of assessment - Spatial Scope)];

[31] Council of Europe, 20/10/2000 Florence, European Landscape Convention CETS No.: 176.

- definition of the landscape character areas (see paragraphs 12.2.7 and 12.2.8);
- assessment of the condition, tranquillity and value of each of the character areas (see paragraphs 12.2.9 to 12.2.12);
- establishment of the sensitivity of each of the character areas (see paragraph 12.2.14);
- definition of viewpoints representative of groups of visual receptors within the ZTV (see paragraph 12.2.15);
- definition of the type and nature of the view from each viewpoint (see paragraph 12.2.17); and
- determination of the magnitude of change for each character area (see paragraph 12.6.2) and visual receptor (see paragraph 12.6.9).

12.2.2 *[Paragraph 12.2.7 supplemented with:]* The character area boundaries will follow natural changes in the landscape rather than political or administrative boundaries.

12.2.3 *[Paragraph 12.2.12 supplemented with:]* Further detail on how the level of tranquillity is determined for individual landscape character areas in urban and rural areas is provided in the Approach to tranquillity assessment technical note (see Annex G of the SMR Addendum).

12.2.4 *[Table 19 amended to:]*

Table 19: Visual sensitivity

| Sensitivity | Level of interaction with the landscape |
|---|---|
| High | Occupiers of residential properties<br>Recreational users or tourists whose attention may be focussed on the landscape<br>Designated or protected views |
| Medium | People travelling along scenic roads through the landscape<br>People staying in hotels and healthcare institutions<br>People walking along residential streets |
| Low | People at work and in educational institutions<br>People engaged in formal sports activities<br>People walking through urban areas (for example commuters)<br>People travelling on main roads through the landscape |

## 12.3 Scope of assessment

### Spatial scope

12.3.1 *[Paragraph 12.5.3 supplemented with:]*

- Operation year 15 – defined as the area over which the components of the Proposed Scheme (including trains) will be visible taking into account the screening effect new planting established as part of the Proposed Scheme may have in summer after 15 years of growth.

12.3.2 *[Paragraph 12.5.5 supplemented with:]* The detailed methodology for producing the ZTV is described in the Zone of theoretical visibility production methodology technical note (see Annex G of the SMR Addendum).

## 12.4 Assessment methodology

### Visual assessment methodology

12.4.1 *[Table 20 amended to:]*

Table 20: Landscape magnitude of change

| Impact magnitude | Definition |
|---|---|
| High | Total loss or substantial alteration to key characteristics of the character and/or setting of the character area<br>Addition of new features or components that substantially alter the character and/or setting of the character area<br>Introduction of elements that markedly alter the tranquillity of the character area |
| Medium | Noticeable change or alteration to one or more key characteristics of the character and/or setting of the character area<br>Addition of new features or components that form prominent elements of the character and/or setting of the character area, but are largely characteristic of the existing setting<br>Introduction of elements that noticeably alter the tranquillity of the character area |
| Low | Slight loss or alteration to one or more characteristics of the character and/or setting of the character area<br>Addition of new features or components that form largely inconspicuous elements of the existing character and/or setting<br>Introduction of elements that discernibly alter the tranquillity of the character area |
| Negligible | No change to, or barely perceptible loss or alteration of inconspicuous characteristics of the character and/or setting of the character area<br>Addition of new features or components that do not influence the overall character and/or setting of the character area, or are entirely characteristic of the existing setting<br>Introduction of elements that make no perceptible change to the tranquillity of the character area |

12.4.2 *[Table 22 amended to:]*

Table 22: Visual magnitude of change

| Impact magnitude | Definition |
|---|---|
| High | Total loss or substantial alteration to key characteristics of the view from a receptor<br>Addition of new features or components that are continuously highly visible and incongruous with the existing view from a receptor<br>Substantial changes in close proximity to the visual receptor, within the direct frame of view |
| Medium | Noticeable change or alteration to one or more key characteristics of the view from a receptor<br>Addition of new features or components that may be continuously highly visible, but are largely characteristic of the existing view from a receptor<br>Changes a relatively short distance from the receptor, but viewed as one of a series of components in the middle ground of the view<br>Substantial change partially filtered by intervening vegetation and/or built form, or viewed obliquely from the visual receptor |
| Low | Slight loss or alteration to one or more characteristics of the view from a receptor<br>Addition of new features or landscape components that may be continuously or intermittently visible, but are largely characteristic of the existing view from a receptor<br>Changes within the background of the view, viewed as one of a series of components in the wider panoramic view from a receptor<br>Change largely filtered by intervening vegetation and/or built form, or viewed obliquely from the visual |

| Impact magnitude | Definition |
|---|---|
| | receptor |
| Negligible | No change to, or barely perceptible loss or alteration of inconspicuous characteristics of the view from a receptor.<br>Addition of new features or landscape components that are largely inconspicuous and characteristic of the existing site when viewed from a receptor<br>Changes within the background of the view, viewed as an inconspicuous element within the wider panoramic view from a receptor<br>Change from a visual receptor almost entirely obscured by intervening vegetation and/or built form |

## *Verifiable photomontage methodology*

12.4.3 *[Paragraph 12.6.12 supplemented with:]* The detailed methodology for producing the verifiable photomontages is described in the 'Approach to verifiable photomontages ' technical note (see Annex G of the SMR Addendum).

# 13 Socio-economics

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 13.1.2 | Paragraph deleted |
| 13.1.3 | Paragraph deleted and replacement text provided within SMR Addendum. |
| 13.4.1 | Paragraph deleted and replacement text provided within SMR Addendum. |
| 13.5.1(Table 24) | Third row in Table 24 deleted |
| 13.5.2 | Paragraph deleted and replacement text provided within SMR Addendum. |
| 13.6.13 | Paragraph deleted and replacement text provided within SMR Addendum. |
| **Technical Notes – appended to this document** | |
| It is to be noted that for the purpose of the Technical notes, the topic areas of community and socio-economics have been combined, and are contained within Annex B. | |

## 13.1 Introduction

13.1.1 *(Paragraph 13.1.3 amended to:)* The assessment will also complement the wider business case for HS2, focusing on the identifiable implications for jobs, skills and development, particularly along the route of the Proposed Scheme and elsewhere (e.g. relevant locations on the WCML). The assessment is distinguished from the wider business case in that it will identify direct and significant impacts on local economies. The wider business case is related to, but differs from, the socio-economic assessment in that it predicts overall benefits to the output of the national economy. Benefits to the national economy arise through the circulation of monies over a wide area, which may not have directly observable or significant consequences in the context of EIA.

## 13.2 Key aspects of the Proposed Scheme for the topic

13.2.1 *(Paragraph 13.4.1 amended to:)* Relevant aspects of the Proposed Scheme include:

- direct and indirect effects of construction and operation;
- Demand for labour, particularly during construction, including labour skills and sources;
- Relocation of businesses during construction, e.g. for development of new stations/interchanges;
- Indirect effects on businesses and labour markets served by the existing WCML and any other lines affected by the Proposed Scheme;
- The economic and land use effects of changes in accessibility; and
- Wider catalytic effects and city regeneration.

## 13.3 Scope of assessment

### Temporal scope

13.3.1 *(Paragraph 13.5.2 amended to:)* The temporal scope is outlined in Section 2.2 (Scope of assessment). Socio-economic impacts will generally be assessed for the construction period (2018-26) and first year of operation.

## 13.4 Assessment methodology

### Cumulative effects

13.4.1 *(Paragraph 13.6.13 amended to:)* Cumulative effects will be identified on the basis of a high level assessment of other developments individually or cumulatively in the planning pipeline that have the potential to interact significantly with the Proposed Scheme. Other developments will include major infrastructure projects and large scale urban development (e.g. extensions to urban areas). The known characteristics of such developments will be converted into an employment effect using productivity assumptions and identified in relation to the Proposed Scheme's own timeline.

# 14 Sound, noise and vibration

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 14.2.2 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.2 | Supplementary text provided as new paragraph after 14.2.2 within SMR Addendum |
| 14.2.7 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.2.13 | Paragraph deleted and replacement text provided within SMR Addendum |
| Table 29 | Table deleted and replacement provided within SMR Addendum |
| 14.2 | Supplementary text provided as new paragraph after 14.2.22 within SMR Addendum |
| 14.2 | Supplementary text provided as new paragraph after 14.2.18 within SMR Addendum. |
| 14.2 | New heading 'Impact criteria' inserted after 14.2.20 |
| 14.2 | Supplementary text provided as new paragraph after 14.2.20 within SMR Addendum |
| 14.2.23 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.2.24 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.2 | New heading 'Impact criteria – indirect effects' inserted after 14.2.27 |
| 14.2 | Supplementary text provided as new paragraph after 14.2.27 within SMR Addendum |
| 14.2.32 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.3.6 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.3.14 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.3.15 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.3 | Supplementary text provided as new paragraph after 14.3.17 within SMR Addendum |
| 14.3.19 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.3 | New heading 'Impact Criteria- Direct Impacts' inserted after 14.3.23 |
| 14.3 | Supplementary text provided as new paragraph after 14.3.23 within SMR Addendum |
| 14.3.25 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.3.26 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.3 | New heading 'Impact criteria- indirect impacts' inserted after Table 34 |
| 14.3 | Supplementary text provided as new paragraph after Table 34 within SMR Addendum |
| 14.3 | Supplementary text provided as new paragraph after 14.3.26 within SMR Addendum |
| 14.3 | Additional sub-sub-section heading inserted after 14.3.30: **Significance Criteria** |
| 14.3.34 | Paragraph deleted and replacement text provided within SMR Addendum |
| 14.3.35 | Paragraph deleted and replacement text provided within SMR Addendum |

## 14.1 Ground-borne Sound and Vibration

### Introduction

14.1.1 *[Paragraph 14.2.2 amended to:]* Without mitigation, ground-borne vibration created by either construction activities or train services can propagate through the ground to surrounding buildings where it may result in the vibration of floors, walls and ceilings; and which could also be heard as a low frequency 'rumbling' sound (called ground-borne sound).

### *Ground-borne vibration*

14.1.2 *[Paragraph 14.2.7 amended to:]* The exceptions are receptors close to existing rail sources. Baseline vibration will be calculated, as required, in these locations and verified by focused surveys.

## Key aspects of the Proposed Scheme for the topic

14.1.3 *[Paragraph 14.2.13 amended to:]* 'Best practicable means' will be used to control and mitigate temporary construction noise and vibration effects consistent with legislation and best practice. 'Best practicable means' will include consideration of working methods, working hours, selection of plant, logistical planning and proactive community engagement. The framework for determining such mitigation on a site-by site basis will be set out in the Code of Construction Practice.

14.1.4 *[Supplementary text provided as a new paragraph after 14.2.18:]* Relevant policy includes the NPPF, the Noise Policy Statement for England 2010 and the Government's emerging planning guidance[32] on noise (NPPG).

## Assessment methodology

14.1.5 [*Table 29 amended to:]*

Table 29: Ground-borne sound impact criteria for non-residential receptors

| **Category of Building** | **Impact criterion dB $L_{pAS,max}$ (Measured inside the noise sensitive part of the receptor)** |
|---|---|
| Theatres / large auditoria and concert halls | 25 |
| Sound recording / broadcast studios | 30 |
| Places of meeting for religious worship / courts / cinemas lecture theatres / museums / small auditoria or halls | 35 |
| Offices / schools / colleges / hospitals / hotels / libraries | 40 |

## Impact Criteria – Direct Impacts

14.1.6 *[Supplementary text provided as a new paragraph after 14.2.20]* The impact criteria differ according to the nature of the noise source, the sensitivity of the receptor and the local context so that it reflects the effect that the noise or vibration of the Proposed Scheme exerts on the receptor. Therefore, the impact criteria are representative of what Government's emerging National Planning Practice Guidance describes as the effect on the receptor

## Ground-borne vibration: buildings - construction and operation

14.1.7 [*Supplementary text provided as a new paragraph after 14.2.22:]* Vibration from the operation of the permanent railway and all construction will be assessed in terms of the potential impact on buildings using the criteria presented in Table 30.

14.1.8 *[Paragraph 14.2.23 amended to:]* Guidance on the impact and effect of vibration on people in buildings is presented in BS6472: 2008.[33] Part 1 of the standard assesses the impact of vibration using the Vibration Dose Value (VDV). This is an indicator taking

[32] Emerging National Planning Practice Guidance – Noise: http://planningguidance.planningportal.gov.uk
[33] British Standards Institute (BSi), 2008, 6472 *Guide to evaluation of human exposure to vibration in buildings Parts 1 and 2*, BSi.

into account how people respond to vibration in terms of frequency content, vibration magnitude and the number of vibration events during an assessment period.

### Ground-borne vibration: disturbance of occupants and users of buildings - construction and operation

14.1.9 *[Paragraph 14.2.24 amended to:]* Vibration from the operation of the permanent railway and all construction will be assessed in terms of the potential impacts and adverse effects due to disturbance of occupants and users of buildings using the criteria presented in Table 31.

### Impact Criteria – Indirect Impacts

14.1.10 *(Supplementary text provided as a new paragraph after 14.2.27:]* The impact criteria differ according to the nature of the noise source, the sensitivity of the receptor and the local context so that it reflects the effect that the noise or vibration of the Proposed Scheme exerts on the receptor. Therefore, the impact criteria are representative of what Government's emerging National Planning Practice Guidance describes as the effect on the receptor

### Cumulative effects

14.1.11 *[Paragraph 14.2.32 amended to:]* Community, ecological or heritage adverse effects arising from impacts and effects identified for ground-borne noise and vibration will be considered and reported in the relevant sections of the ES.

## 14.2 Airborne sound

### Establishment of baseline and definition of survey

14.2.1 *[Paragraph 14.3.6 amended to:]* Initially, existing data will be gathered to form the 'desk top' baseline (Baseline 1). Baseline 1 data will be used early in the programme to support initial dialogue, assessment work and design development. Initial field surveys will be undertaken during the summer of 2012 to fill gaps in Baseline 1 data and provide more detailed information at locations where significant effects are likely. Combined with Baseline 1, these data will form Baseline 2, to be used for the draft ES. Further, more targeted surveys will be undertaken in early 2013, responding to the findings of the draft ES assessments and ongoing stakeholder dialogue. Combined with Baseline 2, these data will provide Baseline 3 and 4 for the ES.

### Scope of assessment

14.2.2 *[Paragraph 14.3.14 amended to:]* Temporal scope - the Proposed Scheme will be assessed, as necessary, in the short term at the year of opening; and in the long-term with the highest rail traffic patterns forecast for the first 15 years of operation. These will be compared, as necessary, with the future baseline in 2026 (without the Proposed Scheme).

### Assessment methodology

*Legislation and Guidance*

14.2.3 [Paragraph 14.3.17 amended to:] Relevant legislation includes the Control of Pollution Act 1974, the Environmental Protection Act 1990, the Noise and Statutory Nuisance

Act 1993, the Land Compensation Act 1973 (including the Noise Insulation Regulations) and the European Communities Act 1972 (including the Environmental Noise (England) Regulations 2006) (all as amended).

14.2.4 [Supplementary text provided as a new paragraph after 14.3.17:] Relevant policy includes the NPPF, the Noise Policy Statement for England 2010 and the Government's emerging NPPG.

14.2.5 *[Paragraph 14.3.19 amended to:]* The airborne sound generated by construction activities will be calculated in line with the method set out in BS5228-1.

### Impact criteria - direct impacts

14.2.6 *[Supplementary text provided as a new paragraph after 14.3.23]* The impact criteria differ according to the nature of the noise source, the sensitivity of the receptor and the local context so that it reflects the effect that the noise or vibration of the Proposed Scheme exerts on the receptor. Therefore, the impact criteria are representative of what Government's emerging National Planning Practice Guidance describes as the effect on the receptor.

*Airborne sound – (road or rail)*

14.2.7 *[Paragraph 14.3.25 amended to:]* During the day (0700-2300), an operational noise adverse or beneficial effect on a receptor will be identified where the impact of the Proposed Scheme is:

- An absolute free-field sound level at or above 50 dB $L_{pAeq,16hr}$; and
- Where the magnitude of the impact and its effect on a receptor is indicated by the change in the equivalent continuous sound level as defined in Table 33.

14.2.8 During the day (0700-2300), an operational noise significant adverse effect on residential receptors will be identified where the impact of the Proposed Scheme is:

An absolute free-field sound level at or above 65 dB $L_{pAeq,16hr}$.

14.2.9 *[Paragraph 14.3.26 amended to:]* During the night (2300-0700), an operational noise adverse or beneficial effect on a receptor will be identified where the impact of the Proposed Scheme is:

- An absolute free-field sound level at or above 40 dB $L_{pAeq,8hr}$; and
- Where the magnitude of the impact and its effect on a receptor is indicated by the change in the equivalent continuous sound level as defined in Table 33.

14.2.10 During the night (2300-0700), an operational noise significant adverse effect will be identified on residential receptors where the impact of the Proposed Scheme is:

An absolute free-field sound level at or above 55 dB $L_{pAeq,8hr}$; or

- An absolute sound level above 85 dB $L_{pAFmax}$ at the façade (outside) of a residential receptor (where the number of events exceeding this value is less than or equal to 20); or

- An absolute sound level above 80 dB $L_{pAFmax}$ at the façade (outside) of a residential receptor (where the number of events exceeding this value is greater than 20).

14.2.11 *[Supplementary text provided as a new paragraph after 14.3.26:]* By exception, impacts and resulting adverse or beneficial effects may also be identified following consideration of any unique features of the sound impact from the Proposed Scheme and/or the character of the existing soundscape.

### Impact criteria - indirect impacts

14.2.12 *[Supplementary text provided as a new paragraph after Table 34:]* The impact criteria differ according to the nature of the noise source, the sensitivity of the receptor and the local context so that it reflects the effect that the noise or vibration of the Proposed Scheme exerts on the receptor. Therefore, the impact criteria are representative of what Government's emerging National Planning Practice Guidance describes as the effect on the receptor.

14.2.13 *[Additional sub-sub-section heading inserted after 14.3.30:]* **Significance Criteria**

### Cumulative and Combined Effects

14.2.14 *[Paragraph 14.3.34 amended to:]* Community, ecological, landscape/visual (including tranquillity) or heritage effects arising from impacts and effects identified for airborne sound will be considered and reported in the relevant section of the ES.

14.2.15 *[Paragraph 14.3.35 amended to:]* Secondary effects (e.g. on landscape) associated with mitigation (e.g. noise barriers) proposed to reduce or remove significant airborne sound effects will be considered under the relevant section of the ES.

# 15 Traffic and transport

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| Paragraph 15.6.9 | Supplementary text provided within SMR Addendum. |
| Paragraph 15.6.11 | Supplementary text provided within SMR Addendum. |
| Paragraph 15.6.12 and Table 35 | Text deleted and replacement text provided within SMR Addendum |
| Paragraph 15.6.22 | Supplementary text provided within SMR Addendum. |
| Paragraph 15.6.28 and Table 37 | Table deleted and replacement text provided within SMR Addendum |
| **Technical Notes – appended to this document** | |
| Guidance on further development of significance criteria | |

## 15.1 Assessment methodology

### Significance criteria

15.1.1 *[Paragraph 15.6.9 supplemented with:]* Effects that are of duration less than four consecutive weeks in any 12 month period will be assessed as being not significant.

15.1.2 *[Paragraph 15.6.11 supplemented with:]* Effects that are of duration less than four consecutive weeks in any 12 month period will be assessed as being not significant.

15.1.3 *[Paragraph 15.6.12 amended to:]* The changes in journey times will be defined in proportion to the scale of the impacts being assessed, for example: as not significant (less than one minute); minor (between one and two minutes); moderate (between two and three minutes) and major (greater than three minutes); and the numbers of travellers affected as: minor (less than 200 in total per day); moderate (between 200 and 1,000 per day) and major (greater than 1,000 per day). The significance of the impacts are based on the matrix shown in Table 35, where beneficial impacts occur if journey times are reduced or adverse impacts if journey times are increased.

15.1.4 *[Table 35 amended to:]*

Table 35: Significance levels for travellers affected by delay during construction

| | **Journey time changes** | | |
|---|---|---|---|
| Number of travellers affected | Minor | Moderate | Major |
| Minor | Neutral | Neutral | Minor |
| Moderate | Neutral | Minor | Moderate |
| Major | Minor | Moderate | Major |

15.1.5 *[Paragraph 15.6.22 supplemented with:]* Effects that are of duration less than four consecutive weeks in any 12 month period will be assessed as being not significant.

15.1.6 *[Paragraph 15.6.28 amended to:]* Table 37 provides guidance on how the categories are combined to estimate the numbers of people likely to be affected by changes in severance.

15.1.7 *[Table 37 amended to:]*

Table 37: Assessment of Change in Severance Scoring

| **Numbers of travellers affected** | **Change in severance scoring with the Proposed Scheme** | | | |
|---|---|---|---|---|
| negligible numbers | Not significant | Minor | Moderate | Major |
| Minor numbers | Not significant | Minor | Minor | Minor*/Moderate** |
| Moderate numbers | Not significant | Minor | Moderate | Major |
| Major numbers | Not significant | Minor | Major | Major |

Notes: * duration between four weeks and four months; and

** duration four months or more

15.1.8 Further information is provided within the technical note - Guidance on further development of significance criteria (see Annex I of the SMR Addendum) which discusses:

- determining the magnitude of impacts;
- determining receptor sensitivity; and,
- the classification of construction and operational effects as being of minor, moderate or major significance.

# 16 Waste and material resources

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 16.1.1 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.1.4 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.1.9 | Paragraph deleted and replacement text provided within SMR Addendum. |
| 16.1 | Supplementary text provided as new paragraph after 16.1.9 within SMR Addendum to clarify scope of assessment. |
| 16.2.2 | Paragraph deleted and replacement text provided within SMR Addendum. |
| 16.2.7 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.2.8 | Paragraph deleted as no longer relevant to scope and methodology |
| 16.5.1 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.5 | Supplementary text provided as new paragraph after 16.5.1 within SMR Addendum to clarify spatial scope. |
| 16.5 | Supplementary text provided as new paragraph after 16.5.1 within SMR Addendum to clarify temporal scope. |
| 16.5.2 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.5.6 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.6.1 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.6.2 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.6.4 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.6.4 to 16.6.5 | Details of relevant legislation added as supplementary paragraphs between 16.6.4 and 16.6.5. |
| 16.6.5 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.6.8 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.6.10 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.6 | Supplementary text provided as new paragraph after 16.6.10 within SMR Addendum to provide reference to Technical Note. |
| Table 38 | Table deleted |
| Table 39 | Table deleted |
| 16.6.11 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.6.12 | Paragraph deleted and replacement text provided within SMR Addendum. |
| 16.6 | Supplementary text provided as new paragraph after 16.6.12 within SMR Addendum to provide reference to Technical Notes. |
| 16.6.13 | Paragraph deleted and replacement text provided within SMR Addendum |
| 16.6 | Supplementary text provided as new paragraph after 16.6.13 within SMR Addendum to provide reference to Technical Note. |
| 16.7.3 | Paragraph deleted. |
| **Technical Notes – appended to this document** | |
| Rationale for landfill significance criteria | |
| Waste forecast and assessment methodology | |

## 16.1 Introduction

16.1.1 *[Paragraph 16.1.1 amended to:]* This section of the report describes the scope and methodology that will be used to assess the likely significant environmental effects associated with the generation and management of solid waste during the construction and operational phases of the Proposed Scheme.

16.1.2 *[Paragraph 16.1.4 amended to:]* The likely significant environmental effects from the use of materials (e.g. aggregate, concrete, brick and steel) for the construction of the Proposed Scheme will not be addressed in the EIA.

16.1.3 *[Paragraph 16.1.9 deleted and replacement text provided:]* The following types of waste to be generated by construction of the Proposed Scheme will be considered in the assessment:

- excavation wastes;
- demolition wastes;
- construction wastes; and
- worker accommodation site waste.

16.1.4 *[Section 16.1 – additional text inserted as new paragraph after 16.1.9:]* The following types of waste to be generated by operation of the Proposed Scheme will be considered in the assessment:

- railway station and train waste;
- rolling stock maintenance waste;
- track maintenance waste; and
- ancillary infrastructure waste.

## 16.2 Establishment of baseline and definition of survey

16.2.1 *[Paragraph 16.2.2 amended to:]* A baseline will be developed for waste and material resources as part of the EIA. Baseline conditions will be identified with respect to:

- types, quantities and management of construction, demolition and excavation waste arisings generated in England and within each of the county and former regional planning jurisdictions through which the route of the Proposed Scheme will pass;
- types, quantities and management of commercial and industrial waste generated in England and within each of the county and former regional planning jurisdictions through which the route of the Proposed Scheme will pass; and
- availability (types and capacity) of waste infrastructure within each of the county and former regional planning jurisdictions through which the route of the Proposed Scheme will pass.

16.2.2 *[Paragraph 16.2.7 amended to:]* The waste and minerals plan, together with any relevant evidence which supports it and up to date waste capacity information held by

the Environment Agency, will be used to indicate where and how much landfill void space is likely to be available during construction (2017 to 2025) and operation (2026) of the Proposed Scheme. This information will be used to assess whether or not there is likely to be a shortfall of suitable landfill void space for the management of waste requiring off-site disposal to landfill.

## 16.3 Scope of assessment

16.3.1 *[Paragraph 16.5.1 amended to:]* The likely significant environmental effects of solid waste generation associated with the Proposed Scheme will be assessed with respect to both the construction and operational phases. These effects may be beneficial or adverse dependent on the measures employed to prevent and/or manage the waste generated.

### Spatial Scope

16.3.2 *[Section 16.5 supplemented with:]* Waste and material resources shall be assessed on a route-wide basis having regard to the local (i.e. counties or London boroughs) and regional (i.e. former regional planning jurisdictions) areas along the route. The latter is significant with respect to historical methods of waste infrastructure planning and capacity reporting.

### Temporal scope

16.3.3 *[Section 16.5 supplemented with:]* The temporal scope of the assessment shall be 2017 to 2025 for construction (i.e. the proposed construction period) and 2026 for operation (i.e. the first full year of operation of the Proposed Scheme).

### Construction

16.3.4 *[Paragraph 16.5.2 amended to:]* Construction effects will address the temporary, indirect effects of solid waste that will be generated by earthworks, demolition and construction activities and that will require off-site disposal during the proposed construction period. The scope of the assessment of construction effects will also include waste generation and its off-site disposal to landfill associated with the worker accommodation sites during the same time period. Demolition materials will be generated as a result of site clearance works and from the demolition of buildings and other structures currently in existence along the route of the Proposed Scheme. Natural, uncontaminated and contaminated excavated material is likely to be generated as a result of construction of the Proposed Scheme. It is likely that the majority of the excavated material will comprise natural and inert soils.

### Operation

16.3.5 *[Paragraph 16.5.6 amended to:]* Operational effects will address the permanent, indirect impacts of solid waste that will be generated and require off-site disposal to landfill during the first full year operation of the Proposed Scheme. This includes solid waste that will be generated by passengers and staff at new and redeveloped stations, and at staff depots and rail maintenance facilities. Waste will also be generated by passengers and staff on trains whilst these are in use along the route of the Proposed Scheme and from track maintenance works.

## 16.4 Assessment methodology

16.4.1 *[Paragraph 16.6.1 amended to:]* There is no recognised methodology or waste significance criteria to assess the likely significant environmental effects of solid waste generation from either construction or operation. The proposed assessment methodology is, therefore, based on EIA practitioners' professional judgement and experience with the application of EIA to rail-related and other large scale transport infrastructure projects.

16.4.2 *[Paragraph 16.6.2 amended to:]* The assessment will consider the types and quantities of solid waste that will be generated during construction and operation, and the severity of the likely significant environmental effects that may arise from the quantity of waste requiring disposal to landfill (this being a finite and least preferred waste management option). The assessment will consider waste arisings and waste infrastructure capacity in local and regional areas through which the route of the Proposed Scheme will pass.

### Legislation and guidance

16.4.3 *[Paragraph 16.6.4 amended to:]* The Waste (England and Wales) Regulations 2011 SI No. 988[34] (as amended), which transpose the provisions of the 'EU Waste Framework Directive' (2008/98/EC)[35] into England and Wales.

16.4.4 *[additional text added after 16.6.4 as follows:]* The Controlled Waste (England and Wales) Regulations 2012 SI No. 811[36] (as amended), which sets out the definition of controlled waste to which regulatory waste management controls apply.

16.4.5 The Environmental Permitting (England and Wales) Regulations 2010 SI No. 675[37] (as amended), which provide a consolidated system for permitting of waste operations.

16.4.6 The Hazardous Waste (England and Wales) Regulations 2005 SI No. 894[38] (as amended), which sets out the regime for the control and tracking of the movement of hazardous waste.

16.4.7 The List of Wastes (England) Regulations 2005 SI No. 895[39] (as amended), which provides for the classification of wastes and determination of hazardous wastes.

16.4.8 *[Paragraph 16.6.5 amended to:]* The Site Waste Management Plans Regulations 2008 SI No. 314[40] require the preparation of a site waste management plan (SWMP) for any construction project with an estimated capital cost of over £300,000. The purpose of the SWMP is to identify opportunities to design out waste; as well as identifying the types and quantities of waste likely to be produced during construction; the opportunities for sustainable management of the waste identified; and to monitor and report on the actual management of these wastes throughout the construction period. It is acknowledged that these regulations are likely to be repealed as a result of

[34] *The Waste (England and Wales) Regulations 2011 (SI 2011 No. 988).* London, Her Majesty's Stationery Office.
[35] *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on Waste and Repealing Certain Directives.*
[36] *The Controlled Waste (England Wales) Regulations 2012 (SI 2012 No. 811).* London, Her Majesty's Stationery Office.
[37] *The Environmental Permitting (England and Wales) Regulations 2010 (SI 2010 No. 675).* London, Her Majesty's Stationery Office.
[38] *The Hazardous Waste (England and Wales) Regulations 2005 (SI 2005 No. 894).* London, Her Majesty's Stationery Office.
[39] *The List of Wastes (England) Regulations 2005 (SI 2005 No. 895).* London, Her Majesty's Stationery Office.
[40] *The Site Waste Management Plans Regulations 2008 (SI 2008 No. 314).* London, Her Majesty's Stationery Office.

consultation proposed by the Defra Red Tape Challenge[41]. However, HS2 Ltd will apply an integrated approach to the design of the Proposed Scheme aiming to maximise the beneficial re-use of materials where possible, and minimise the generation of waste, which will be facilitated through the implementation of the Code of Construction Practice for the Proposed Scheme.

16.4.9 *[Paragraph 16.6.8 amended to:]* Regional and local planning policy, such as The London Plan: Spatial Development Strategy for London[42], which sets out strategic planning policies for the management of waste generated in Greater London and elsewhere along the route of the Proposed Scheme. Specifically, these policies seek to minimise the amount of waste generated, increase the reuse and recycling of waste and reduce waste to landfill.

### Significance criteria

16.4.10 *[Paragraph 16.6.10 amended to:]* There are no recognised significance criteria against which direct and indirect waste effects for both the construction and operational phases of the Proposed Scheme can be assessed. As such, the criteria for the assessment have been derived from professional experience previously gained from the application of EIA to large-scale infrastructure projects, which take into account:

- the net change in solid waste arisings overall as a result of the Proposed Scheme;
- the magnitude of the quantity of waste requiring landfill disposal; and
- the availability of landfill disposal capacity in the local and regional area.

Significance criteria to be used for the assessment of the likely significant environmental effects of solid waste generation are provided in the Rationale for landfill significance criteria technical note (see Annex J of the SMR Addendum).

### Construction effects

16.4.11 *[Paragraph 16.6.11 amended to:]* The assessment will identify the types and quantities of solid waste forecast to be generated during each of the demolition, excavation and construction stages of the Proposed Scheme. It will also identify types and quantities of waste forecast to be generated by occupants of the worker accommodation sites during the overall construction programme. Quantification will be on the basis of survey information, using published waste generation rates or forecasting tools such as the WRAP Net Waste Tool.

16.4.12 *[Paragraph 16.6.12 amended to:]* Assumptions regarding the type and quantity of waste to be diverted from landfill via reuse, recycling and recovery will be applied. Following this, the type and quantity of demolition materials, excavated materials, construction materials and worker accommodation site waste requiring landfill disposal will be assessed in relation to the projected quantity of landfill disposal capacity in the designated local and regional areas throughout the proposed construction period.

[41] Department for Environment, Food and Rural Affairs; *Red Tape Challenge – Environment Theme Proposals March 2012*; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69584/pb13728-red-tape-environment.pdf; Accessed 24 September 2013.
[42] Greater London Authority (2011), The London Plan: Spatial Development Strategy for Greater London.

16.4.13 *[Section 16.6 – additional text inserted as new paragraph after 16.6.12:]* Further information regarding the waste forecasting and assessment methodology for construction effects is provided in the Waste forecast and assessment methodology technical note (see Annex J of the SMR Addendum)..

## Operational Effects

16.4.14 *[Paragraph 16.6.13 amended to:]* The assessment will identify the types and quantities of solid waste forecast to be generated during the first full year of operation of the Proposed Scheme. This forecast will be based on an assumption of maximum capacity of the Proposed Scheme and any effects will be assumed to be annual. Quantification may be on the basis of existing operational waste management performance data (e.g. for stations/interchanges) or using published operational waste generation rates for the relevant land use activities.

16.4.15 *[Section 16.6 – additional text inserted as new paragraph after 16.6.13:]* Further information regarding the waste forecasting and assessment methodology for operational effects is provided in the Waste forecast and assessment methodology technical note (see Annex J of the SMR Addendum).

# 17 Water resources and flood risk assessment

List of amendments to the SMR for this topic

| SMR Paragraph Reference/Table Number | Note |
|---|---|
| 17.2.3 | Text within paragraph clarified within SMR Addendum |
| Table 40 | Table deleted and replacement provided within the SMR Addendum |
| 17.5.1 | Paragraph deleted and replacement text provided within SMR Addendum |
| 17.5.2 | Paragraph deleted and replacement text provided within SMR Addendum |
| 17.6.4 | Paragraph deleted and replacement text provided within SMR Addendum |
| Table 41A and 41B | Table deleted and replacement Table41 provided within the SMR Addendum |
| Table 42 | Table deleted and replacement provided within the SMR Addendum |
| 17.6.6 | Paragraph deleted and replacement text provided within SMR Addendum |
| **Technical Notes – appended to this document** | |
| Surface water quality assessment | |
| Ground water assessment method | |
| Spillage risk assessment | |

## 17.1 Establishment of baseline and definition of survey

17.1.1 *[Paragraph 17.2.3 clarified with]* Baseline conditions will be set, where appropriate, for:

- surface water quantity and quality and Water Framework Directive (WFD) chemical and ecological status; and
- groundwater quality and quantity (including WFD chemical and quantitative status);

17.1.2 [*Table 40 amended to*]

Table 40: Baseline Data and sources

| | |
|---|---|
| Flood plain extent, depth, velocity, hazard<br>Surface water flood depths<br>Groundwater level and flow directions<br>Groundwater yield<br>Aquifer extent (vertical and horizontal) and hydraulic parameters | Targeted hydraulic modelling, Information held by the Environment Agency, British Geological Survey, Internal Drainage Boards (IDBs), British Waterways, Water Companies, and Lead Local Flood Authorities. Information contained within local planning authorities'<br>Strategic Flood Risk Assessments and Surface Water Management Plans |
| Surface water quality Groundwater quality | Targeted water sampling and testing at accredited laboratory. Information held by the Environment Agency, River Basin Management Plans, Local Authorities, Water companies |
| Surface water designations | Information held by the Environment Agency and Natural England |
| Surface water licences/consents<br>Groundwater licences/permits<br>Unlicensed abstractions | Information held by the EA and/or LLFAs<br>Information held by the EA and/or LLFAs<br>Information held by local authorities |
| Hydro-meteorological data, as needed | Met Office, Environment Agency |

## 17.2 Scope of assessment

*Spatial scope*

17.2.1 *[paragraph 17.5.1 amended to]* The spatial scope of the assessment will be based upon the identification of surface water and groundwater features within 1km of the centreline of the Proposed Scheme, except where there is clearly no hydraulic connectivity and in urban areas where the extent will be 500m, as outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme.

17.2.2 *[paragraph 17.5.2 amended to]* Where works extend more than 200m from the centreline, for example at stations and depots, professional judgement will be made in selecting the appropriate limit to the extension in spatial scope required.

## 17.3 Assessment methodology

### Significance criteria

17.3.1 [*paragraph 17.6.4 amended to*] The significance of an effect is defined by the magnitude of the impact and the overall value of the receiving water body or receptor (the 'attribute') (see Table 41). Table 41, Table 42 and Table 43 have been adapted from the tables in the DMRB (Volume 11.3.10: Road Drainage and the Water Environment). Significant effects on the water environment are those that have a moderate significance of effect or greater.

17.3.2 [*Table 41A and 41B replaced by*]

Table 41: Significance of effects

| **Value of Receptor** | **Magnitude of Impact** | | | |
|---|---|---|---|---|
| | **Negligible** | **Minor** | **Moderate** | **Major** |
| Very high | Neutral | Moderate / Large | Large / Very Large | Very Large - |
| High | Neutral | Moderate | Moderate / Large | Large / Very Large - |
| Moderate | Neutral | Slight | Moderate | Large |
| Low | Neutral | Neutral | Slight | Slight |

17.3.3 [*Table 42 amended to:*]

Table 42: Magnitude of possible impacts

| **Magnitude** | **Criteria** | **Examples** |
|---|---|---|
| Major | Adverse: Loss of an attribute and / or quality and integrity of an attribute | Adverse: Increase in peak flood level* (> 100mm); loss of a fishery; decrease in surface water ecological or chemical WFD status or groundwater qualitative or quantitative WFD status. |
| | Beneficial: Creation of new attribute or major improvement in quality of an attribute | Beneficial: Creation of flood storage and decrease in peak flood level* (> 100mm); increase in productivity or size of fishery; increase in surface water ecological or chemical WFD status; increase in groundwater qualitative or quantitative WFD status. |
| Moderate | Adverse: Loss of part of an attribute or decrease in integrity of an attribute | Adverse: Increase in peak flood level* (> 50mm); Partial loss of fishery; measurable decrease in surface water ecological or chemical quality, or flow; reversible change in the yield or quality of an aquifer; such that existing users are affected, but not changing any WFD status. |
| | Beneficial: Moderate improvement in quality of an attribute | Beneficial: Creation of flood storage and decrease in peak flood level* (> 50mm); Measurable increase in surface water quality or in the yield or quality of aquifer benefiting existing users but not |

| Magnitude | Criteria | Examples |
|---|---|---|
| | | changing any WFD status. |
| Minor | Adverse: Some measurable change to the integrity of an attribute<br><br>Beneficial: Measurable increase, or reduced risk of negative effect to an attribute, | Adverse: Increase in peak flood level*(> 10mm); measurable decrease in surface water ecological or chemical quality, or flow; decrease in yield or quality of aquifer; not affecting existing users or changing any WFD status.<br><br>Beneficial: Creation of flood storage and decrease in peak flood level* (> 10mm); Measurable increase in surface water ecological or chemical quality; increase in yield or quality of aquifer not affecting existing users or changing any WFD status. |
| Negligible | No change to integrity of attribute | Negligible change to peak flood level* (< +/- 10mm); Discharges to watercourse or changes to an aquifer which lead to no change in the attribute's integrity. |

* Peak flood level for a 1% annual probability event, including climate change. Where access or egress routes are affected, the magnitude of the impact will be defined by the change in the Flood Hazard Rating as defined in Defra/EA report FD2320

17.3.4 *[Table 43 amended to:]*

Table 43: Examples of the value of possible water bodies or receptors

| Value | Criteria | Examples[43] |
|---|---|---|
| Very high | Nationally significant attribute of high value | Watercourse having a WFD classification shown in a RBMP and $Q_{95} \geq 1.0\ m^3/s$ , SPZ 1 within a Principal Aquifer, essential infrastructure or highly vulnerable development* |
| High | Locally significant attribute of high value | Watercourse having a WFD classification shown in a RBMP and $Q_{95} < 1.0 m^3/s$, Principal Aquifer, more vulnerable development* |
| Moderate | Of moderate quality and rarity | Watercourses not having a WFD classification shown in a RBMP, Secondary Aquifer, less vulnerable development* |
| Low | Lower quality | Surface water sewer, non aquifer, water compatible development * |

* as defined in Table 2 of the Flood Risk section of the Technical Guidance to the NPPF.

[43] Q95 is the flow equalled or exceeded in a watercourse for 95% of a recording period - typically over several years.

# Annex A: Air quality – technical notes

1.1.1 The following technical notes are appended to this document:

- Air quality assessment for construction issues
- Guidance on assessment methodology

# HS2 London-West Midlands

# Air quality

# Technical note – Air quality assessment for construction issues

## A report to HS2 Ltd by Arup/URS

# Contents



**List of tables**

# 1 Introduction

## 1.1 Purpose of the note

1.1.1 This technical note provides further information on the assessment of air quality during construction of the Proposed Scheme. The Scoping and Methodology Report (SMR) (see Volume 5: Appendix CT-001-000/1) provided guidance that the assessment of construction impacts would follow the recommendations of the Institute of Air Quality Management (IAQM) guidance[1]. This note provides an interpretation of the IAQM guidance for application to the assessment of the Proposed Scheme.

## 1.2 Relevant issues

1.2.1 The IAQM guidance considers the potential air quality impacts during construction to be:

- dust deposition;
- visible dust plumes;
- elevated PM10 concentrations; and
- an increase in concentrations of particulate matter and nitrogen dioxide from exhaust emissions from vehicles and equipment used on site.

1.2.2 The assessment of air quality impacts during construction will also consider the impact of exhaust emissions from vehicles travelling to and from the construction site, particularly the Heavy Duty Vehicles (HDVs). The assessment of impacts from these vehicles is considered to be well covered by existing guidance in the Design Manual for Roads and Bridges (DMRB)[2] and Defra's Local Air Quality Management Technical Guidance TG(09)[3] and is not considered further in this note.

# 2 Methodology

## 2.1 Relevant receptors

2.1.1 The IAQM guidance details two types of relevant receptors that will be taken into account in the assessment – human and ecological receptors.

2.1.2 A human receptor is defined as any location where a person may experience the annoyance effects of airborne dust or dust soiling, or exposure to PM10 over a time period relevant to the air quality standards. For the purposes of the assessment of the Proposed Scheme this is mainly residential dwellings. The IAQM guidance also directs that some commercial premises may have a particular sensitivity to dust, however, the assessment must take into account the actual situation at premises of this type as they may already have protected their operations against increased dust levels. Some horticultural operations are also considered to be dust sensitive.

[1] IAQM, 2012, *Guidance on the assessment of the impacts of construction on air quality and the determination of their significance.*
[2] Highways Agency (2007), *Design Manual for Roads and Bridges, Volume 11, Section 3 Part 1 HA207/07 Air Quality.*
[3] Defra (2009), *Local Air Quality Management: Technical Guidance LAQM.TG(09).*

2.1.3 An ecological receptor is any habitat that may be sensitive to dust soiling from direct impacts (e.g. excessive dust deposition) or indirect impacts on fauna (foraging habitats).

2.1.4 The IAQM guidance suggests that an assessment is required where there are sensitive receptors within 350m of the boundary of the site, within 100m of the route used by construction vehicles on the public highway and up to 500m from the site entrance. It is acknowledged in the guidance that these values are conservative and hence there is scope for specific criteria to be applied for this assessment.

2.1.5 The guidance also states that the assessment should assume that no mitigation measures are applied except those required by legislation, however, the HS2 project intends to apply mitigation at all its major construction sites (where a high or medium level of risk is identified according to the IAQM guidance) to reduce the potential impacts of the development. These mitigation measures are detailed in Table 1 and are based on the requirements for low risks sites in the Greater London Authority (GLA) guidance[4]. With these measures in place and by examining the intensity of construction activities in some instance, the distances described in paragraph 2.1.4 can be reduced without risk of underestimating the air quality impacts.

2.1.6 Detailed assessment of construction impacts will be undertaken in accordance with the following principles:

- where the construction activities fall into a high risk category for either demolition, earthworks, construction or trackout (defined in Sections 8.3-8.7 of the IAQM guidance) then the distances in Section 7 of the IAQM guidance will apply;
- in other situations only sensitive receptors within 200m of the site boundary will be considered; however, it is not possible to draw up an exhaustive list of criteria and professional judgement will be applied in certain cases; and
- reference will be made to the Code of Construction Practice (CoCP) and the Local Environment Management Plan (LEMP) proposed for each community forum area .

[4] Greater London Authority and London Councils (2006), *The control of dust and emissions from construction and demolition: Best Practice Guidance, London: Greater London Authority.*

Table 1: Mitigation measures assumed to be applied at all construction sites

| Activity | Mitigation |
|---|---|
| Site planning | Machinery, fuel and chemical storage and dust generating activities should not be located close to boundaries and sensitive receptors if at all possible.<br>Erect effective barriers around dusty activities or the site boundary. |
| Haul roads | Use consolidated surfaces on haul roads near to residential areas.<br>Use agreed wet cleaning methods or mechanical road sweepers on all roads during periods of dry weather.<br>Clean road edges and pavements using agreed wet cleaning methods. |
| Vehicles | All vehicles should switch off engines - no idling.<br>Clean or wash all vehicles effectively before they leave a site if there is a risk of affecting nearby sensitive receptors.<br>All loads entering and leaving site to be covered. |
| Site entrances/exits | Wash or clean all vehicles effectively before leaving the site if it is close to sensitive receptors.<br>Ideally there should be a paved area between the wheel wash and before the public road. |
| Excavation and earthworks | All dusty activities should be damped down, especially during dry weather.<br>Temporarily cover earthworks if possible.<br>Minimise drop heights to control the fall of materials. |
| Stockpiles | Make sure that stockpiles exist for the shortest possible time. |
| Grinding, cutting, sawing | All equipment should use water suppressant or suitable local exhaust ventilation systems. |
| Chutes and skips | Securely cover skips.<br>Minimise drop heights to control the fall of materials.<br>Regularly damp down surfaces with water. |
| Off road vehicles and plant | All non-road mobile machinery should use fuel equivalent to ultra low sulphur diesel (ULSD), especially where a bunkered fuel supply is available.<br>No vehicles or plant will be left idling unnecessarily.<br>NRMM (vehicles and plant) should be well maintained. Should any emissions of dark smoke occur (except during start up) then the relevant machinery should be stopped immediately and any problem rectified before being used.<br>Engines and exhaust systems should be regularly serviced according to manufacturer's recommendations and maintained to meet statutory limits/opacity tests.<br>All vehicles should hold current MOT certificates where required.<br>Vehicle exhausts should be directed away from the ground and positioned so they are not directed at site entrances.<br>Locate plant away from the boundaries close to residential areas |

## 2.2 Temporal considerations

2.2.1 The assessment of impacts will consider the construction activities throughout the construction period. However, a separate assessment will not be undertaken for every year throughout construction at every site. Nonetheless, the assessment will capture the periods where the risk of adverse impacts are at their highest.

2.2.2 The assessment at each major construction activity will therefore draw upon the construction programme to identify the duration and location of activities that would give rise to air quality impacts. As the IAQM guidance provides a three scale level of risk for various activities that depends on their scale and distances to sensitive

receptors, it is likely that the overall risk will change at different times during the construction period.

2.2.3 The assessment will therefore identify the changes in risk of adverse effects throughout the construction period and set out an appropriate level of mitigation to reduce these. The level of mitigation proposed will be consistent with that proposed in the IAQM guidance document and has been detailed within the draft CoCP (see Volume 5: Appendix CT-003-000). This assessment will identify the periods when there are major changes in the construction activities and assess periods when construction effects may change as a result.

2.2.4 Assessment of construction traffic impacts will follow a similar principle although relatively few sites require detailed modelling of the air quality impacts. Assessment is not required for every year of the construction period although it may be necessary to consider the impacts for more than one year if the levels of routing of traffic change throughout the construction period. A worst case year will be selected based on the year of assessment (which will change the emission and background concentration data) and the volume of traffic generated. Given the reducing emissions and background concentrations, it is very likely that the worst case impacts will be found in the early years of the construction period.

# HS2 London-West Midlands

# Air quality

# Technical note – Guidance on assessment methodology

## A report to HS2 Ltd by Arup/URS

# Contents



**List of tables**

# 1 General considerations

## 1.1 Scenario nomenclature

1.1.1 2012 Current Baseline (for model verification if required).

1.1.2 2017 Construction without the Proposed Scheme – The baseline scenario for construction assessment without the Proposed Scheme in place.

1.1.3 2017 Construction with the Proposed Scheme - The scenario for assessment of the effects of construction of the Proposed Scheme.

1.1.4 2026 Operation without the Proposed Scheme – The scenario without the Proposed Scheme in place ( baseline) against which the assessment of the operation of the Proposed Scheme will be made.

1.1.5 2026 Operation with the Proposed Scheme – The scenario for assessment of the operational effects of the Proposed Scheme.

## 1.2 Baseline data

1.2.1 Baseline monitoring data should be reported from the nearest available sites that represent the location under assessment. Where data capture is less than 90% in a year, commentary will be given on how these data may or may not reflect annual mean data.

## 1.3 Selection and types of receptors

1.3.1 For the assessment of the impacts from roads, receptors will be chosen so the worst affected relevant sensitive exposure (residential properties, schools, hospitals, nursing homes) on each road and at each junction on the assessed road network is represented. If several receptors are present at a junction and it is unclear which of them would be the worst affected receptor, all of the potential worst affected receptors will be modelled. Where there is no sensitive exposure at junctions, receptors will be chosen alongside roads which meet the Design Manual for Roads and Bridges[1] criteria so that all possible worst case effect locations are represented.

1.3.2 For assessment of car parks receptors will be chosen near the perimeter of the car park where worst case effects are likely, considering contributions from other modelled sources (car parks and roads). Additionally, receptors included in any combustion plant assessment or in an independent road traffic assessment nearby the modelled road network will be included in the model runs to account for cumulative effects.

1.3.3 Receptors will be selected based on either their proximity to the combustion source (such as boilers and CHP systems) or as the likely most affected receptors; receptors will include all locations where people might reasonably be (including residential, hotels, nurseries, hospitals, schools, nursing home buildings) and/or ecological receptors if considered sensitive to the pollutant being considered and present on a nationally designated site.

[1] Highways Agency (2007), *The Design Manual for Roads and Bridges (Volume 11, Section 3, Part 1 Air Quality HA207/07).*

1.3.4 If receptors are present in several directions from the stack, the closest receptor in each direction will be selected. The height above ground of the receptors will be set to the height of opening windows and/or air intakes most similar in height to the stack height. Nearby receptors included in any quantitative road and car park assessment will be included in the model runs to account for cumulative effects.

1.3.5 In addition to modelling at selected discrete receptors, a grid of equally spaced receptors will be modelled of at least 50 x 50 points with a maximum spacing of not more than 1.5 times the minimum stack/flue height being modelled. The grid will be centred on the stack(s) and ensure that the maximum off-site concentration is included (this may require several iterations of the model to ensure the optimal spacing is selected). Several grids may also be used. All discrete receptors do not need to be within the area covered by the receptor grid. Maximum concentrations will be reported as well as those at discrete receptors.

1.3.6 Receptors (gridded and/or discrete) will all be at ground level (zero metres above local ground level) and also at various heights above ground if relevant. Consideration will be given in urban areas where there are many receptors at heights more than two metres above ground to modelling a series of grids at various heights (in order to ensure that exposure of receptors at height are considered. Discrete receptors at height may also be used if an elevated grid is not justified.

## 1.4 Interfaces

1.4.1 Any results that relate to receptors within an adjacent Community Forum Area (CFA) will be included as part of that CFA report.

## 1.5 ADMS model parameters

1.5.1 ADMS-Roads[2] meteorological setting will remain as default, except for the surface roughness and minimum Monin-Obukhov length – advice on the relevant values to be used will be taken from the ADMS-Roads Manual based on the characteristics of the study area as follows:

- Large urban areas : 1.5m;
- Cities/Woodlands : 1.0m;
- Parkland, Open Suburbia : 0.5m;
- Agricultural Areas (max) : 0.3m;
- Agricultural Areas (min) : 0.2m;
- Root crops : 0.1m;
- Open Grassland : 0.02m; and
- Short grass : 0.005m

1.5.2 Terrain will not be included in dispersion modelling unless justified using professional judgement.

[2] Cambridge Environmental Research Consultants, ADMS Roads User Guide, September 2011.

## 1.6 Model verification

1.6.1 When undertaking an ADMS-Roads assessment, the model will be verified at selected suitable continuous $NO_2$ and $NO_2$ diffusion tube monitoring sites in accordance with LAQM.TG(09)[3]. Kerbside sites will not be included in the model verification exercise. Adjustment to the model using the procedure detailed In LAQM.TG(09) will be made if the average difference between modelled and monitored $NO_2$ concentrations exceeds 25% of monitored concentrations. DMRB screening method results will not be subject to verification as this method will not be used in areas where a significant air quality impact is likely.

## 1.7 Meteorological data

1.7.1 When dispersion modelling is undertaken, a sensitivity analysis will be performed using five years of hourly sequential meteorological data from a station as indicated below (depending on location). The results for the full assessment will then be presented based on 2011 meteorological data unless the sensitivity analysis justifies another year as likely to lead to results that would materially affect the conclusions of the assessment. Choice of any year other than 2011 will be justified.

1.7.2 The following meteorological stations (Table 1) will be used in the assessment, unless there are particular local features to suggest another site is more appropriate.

Table 1: Meteorological Data

| No. | Met Station | OS X | OS Y | Description of Data |
|---|---|---|---|---|
| 1 | Heathrow | 507733 | 176810 | London Heathrow |
| 2 | Elmdon | 418242 | 283593 | Elmdon/Birmingham Airport with missing cloud from Coventry |

[3] Defra, Local Air Quality Management, Technical Guidance LAQM.TG(09), February 2009.

# 2 Combustion plant assessment

## 2.1 Type of assessment required

2.1.1 Emissions from buildings will be included in the assessment. Professional judgement will be used to determine the most appropriate method for assessment which will be qualitative or quantitative, including dispersion modelling.

2.1.2 The assessment of stationary combustion plant shall comply with the provisions of the Clean Air Act (1993). In summary:

- plant burning less than 45.4kg/hr of solid fuel or thermal input of liquid or gaseous fuel of less than 366.4 kW (or combined plant sharing flues) will be screened out of the assessment; and
- plant falling within the provisions of the Clean Air Act will have their stack/flue height sited at a location and height acceptable under the terms of the Act. This will initially be estimated using the D1 method[4].

2.1.3 Where relevant, professional judgement and/or dispersion modelling will be used to suggest design modifications including height and location of flues/stacks, particularly in relation to any adjacent or neighbouring buildings or structures.

2.1.4 Professional judgement will be exercised to ensure that the criteria given above are appropriate e.g. if there are many small boilers that may each fall under the criteria set out above but cumulatively their effect on air quality may be non-negligible, modelling may be deemed appropriate.

2.1.5 Professional judgement will be used as to whether modelling of plant that is not used throughout the year is appropriate (e.g. back-up generators run only for testing other than in the event of power failure).

2.1.6 Dispersion modelling will be undertaken with the atmospheric dispersion model ADMS and/or ADMS-Roads, using the most up to date version as of the date of receipt of the model input data.

2.1.7 Dispersion modelling of point source emissions will be undertaken if one or more of the following conditions are met:

- the height of stack from the D1 determination is not acceptable for some reason, (e.g. it is unacceptable to the designers, physical limitations relating to use/access); or
- the combustion plant has the potential to affect air quality where the existing or estimated future annual mean baseline $NO_2$ concentrations are over 36 $\mu g/m^3$ or PM10 concentrations are over 30 $\mu g/m^3$ (if the source is non-gas fired) and where impacts are likely to be significant.

2.1.8 For natural gas fired equipment modelling will only be for $NO_2$. For other fuel types (e.g. biomass) consideration will be given to the inclusion of PM10, PM2.5 and/or $SO_2$.

[4] Her Majesty's Inspectorate of Pollution (1993), *Technical Guidance Note (Dispersion) D1: Guidelines on Discharge Stack Heights for Polluting Emissions*. London, Her Majesty's Stationery Office.

2.1.9 Where existing or future air quality is likely to exceed the relevant assessment criteria consideration will be given to the modelling of sources that would be excluded using the above criteria.

## 2.2 Pollutant emissions and model inputs

2.2.1 The D1 and modelling assessments will consider annual mean NOx emissions for gas fired plant and both NOx and PM10 emissions for other fired plant. If a specific combustion plant has not been selected by the energy consultant/mechanical engineer, standard emissions data will be used. Background concentrations for use with the D1 method will be taken from Table 2 of the D1 Technical Guidance using the 'type of district' at the location of the assessed boiler. This information is repeated in Table 2, however, this data will be checked for consistency with available local background concentration information and where good quality local information is available this will be used in preference. To convert locally measured annual mean NO2 concentrations to the 98th percentile values used in D1, a factor of 2.5 will be used.

Table 2: D1 – Typical background levels of common pollutants

| **Type of district** | **Background concentrations, mg/m$^3$** | |
|---|---|---|
| | **NO2*** | **PM10** |
| Major city centre/heavy industrial area | 0.17 | 0.15 |
| Highly developed large urban area | 0.12 | 0.10 |
| Urban area of limited size with parkland or largely rural surroundings | 0.09 | 0.07 |
| Partially developed area | 0.07 | 0.05 |
| Rural area with little development | 0.05 | 0.03 |

* 98$^{th}$ percentile of hourly means

2.2.2 Emission characteristics from Table 3 will be used in any boiler dispersion modelling. Boilers of intermediate size will have their characteristics linearly interpolated using a most similar smaller and most similar larger boiler from the table.

Table 3: Combustion plant model inputs for natural gas CHPs (MW thermal input)

| **Property** | **0.5 MW** | **1 MW** | **2 MW** | **5 MW** | **10 MW** |
|---|---|---|---|---|---|
| Stack height (m) | As per D1 or building ht +1m | | | | |
| Total flow (actual m3/s) | 0.22 | 0.44 | 0.87 | 2.98 | 5.69 |
| Stack/Flue diameter (m) | 0.17 | 0.24 | 0.33 | 0.62 | 0.85 |
| Exit velocity (m/s) | 10 | | | | |
| Discharge temperature (°C) | 72 | 69 | 69 | 179 | 162 |
| NO2 emissions rate g/s (a) | 0.011 | 0.022 | 0.044 | 0.111 | 0.222 |
| Based on the Hoval Ultragas (0.5, 1 and 2 MW) and Royalist range of boilers (5 and 10 MW) | Assumed density of flue gas is the same as nitrogen (1.25 g/l at normal conditions) | | NB this is based on an emission factor of 80 mg/kWh, there may be other local authority advice for the particular study area. | | |

2.2.3 For boilers of intermediate size, emissions will be interpolated and sizes rounded to the nearest 100 kW before interpolation takes place

2.2.4 Assumptions on NOx:NO2 conversion ratios for point source plant NOx emissions will be based on the likely oxidation rates to the point of maximum impact. Where no other data exist, Table 4 will be used to determine the NOx to NO2 oxidation rate for specific distances. It is assumed that the minimum conversion is 10% based on the likely NO2 percentage in the emissions. Linear interpolation will be undertaken between the distances provided to the nearest 10 metres.

Table 4: Oxidation rates (derived from Janssen)[5]

| **Distance from source (m)** | **Estimated annual mean** ozone **concentration (ppb)** | | | |
|---|---|---|---|---|
| | **< 20** | **20-40** | **40-60** | **> 60** |
| 10 | 10% | 10% | 10% | 10% |
| 25 | 10% | 10% | 10% | 10% |
| 50 | 10% | 10% | 10% | 10% |
| 75 | 10% | 10% | 10% | 10% |
| 100 | 10% | 10% | 10% | 10% |
| 200 | 10% | 10% | 10% | 10% |
| 300 | 10% | 10% | 10% | 10% |
| 500 | 10% | 10% | 10% | 14% |
| 750 | 10% | 10% | 14% | 20% |
| 1000 | 10% | 10% | 18% | 26% |
| 1500 | 10% | 15% | 25% | 36% |
| 2000 | 10% | 19% | 32% | 44% |
| 3000 | 14% | 27% | 43% | 57% |

Note: Assuming that wind speed is in the range 5-15m/s, and conversion rates are the highest they would be for the range of ozone given. In reality conversion rates to NO2 would be lower than stated.

2.2.5 All combustion plant sharing a common flue or stack will be combined in a manner that preserves an exit velocity of 15 m/s (the minimum recommended stack emission velocity).

2.2.6 Only annual mean concentrations will require modelling. The handling of short term statistics is explained in Section 3.3.

[5] Janssen et al. (1987) *A Classification of NO Oxidation Rates in Power Plant Plumes Based on Atmospheric Conditions.*

# 3 Assessment of vehicle emissions

## 3.1 Type of assessment required

3.1.1 All affected roads will be assessed. This includes screening out of roads on which traffic changes are likely to lead to negligible effects on air quality.

3.1.2 A DMRB scoping assessment of traffic effects will be undertaken where any of the DMRB criteria, as follows, are met and detailed modelling is not required (see paragraph 3.1.4):

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

3.1.3 Consideration will be given as to whether roads that would be screened out using the above criteria are to be included in the assessment. Examples of this are heavily trafficked roads in areas where air quality criteria may or may not be exceeded, but where traffic changes caused by the construction or operation of the Proposed Scheme are small.

3.1.4 Consideration will be given as to whether dispersion modelling using ADMS-Roads will be carried out, taking into account the following criteria.

- roads screened within the assessment are within the hotspots located within an AQMA (not necessarily if the roads are within an AQMA that has been designated over a wider area than where air quality criteria are exceeded);
- where existing or future estimated annual mean concentrations of $NO_2$ concentrations are over 36 $\mu g/m^3$; and
- where existing or future estimated annual mean PM10 concentrations are over 30 $\mu g/m^3$.

## 3.2 Spatial scope of assessment

3.2.1 Any quantitative air quality assessment will cover the roads which meet the DMRB criteria and roads which adjoin them to enable the effects at junctions to be assessed.

## 3.3 Modelled Pollutants, Model Version and Emissions Factors

3.3.1 Only annual mean NOx and PM10 concentrations are required to be modelled. The treatment of short-term statistics is explained in the following paragraphs.

3.3.2 NOx output from either the DMRB Spreadsheet or ADMS-Roads models for both on road sources and car parks will be combined with the background NOx and $NO_2$ concentrations in the Defra NOx to $NO_2$ conversion spreadsheet, available on the

Defra website[6], to obtain total roadside and background annual mean NO2 concentrations. Modelled combustion plant NO2 contributions will be added to these values to yield a total annual mean NO2 concentration.

3.3.3 The number of exceedances of the 1-hour NO2 objective will not be reported since it is only likely to be breached if the annual mean NO2 concentrations are over 60 µg/m$^3$, (LAQM.TG(09)). Therefore, this less onerous statistic will not to be reported unless there is a very short term activity being examined where high peaks in NO2 concentrations are expected.

3.3.4 To calculate the annual mean PM10 concentrations, the background PM10 concentrations will be added to the road-side concentration output (and any modelled combustion plant output) from the DMRB or ADMS-Roads model. The number of exceedences of the 24-hour PM10 objective should be calculated using the formula in LAQM.TG(09), that is:

No. 24-hour mean exceedences = -18.5 + 0.00145 × annual mean$^3$ + (206/annual mean)

3.3.5 The DMRB Spreadsheet version 1.03c (July 2007)[7] available on the Defra website will be used for any DMRB spreadsheet assessments.

3.3.6 The most recent versions of ADMS-Roads and ADMS will be used for any dispersion modelling assessment. Emissions suitable for use in the ADMS-Roads model will be generated using the most recent Emission Factors Toolkit (EFT) emission factors (COPERT not TRL) (v5.2).

## 3.4 Car Parks, Stationary Idling Vehicles

3.4.1 New car parks will be assessed using ADMS-Roads where they meet the Environmental Protection UK criteria for assessment; that is they have more than 100 spaces outside Air Quality Management Areas (AQMAs) or more than 50 spaces inside AQMAs.

3.4.2 Emissions from movements within the car park will be estimated using EFT as indicated above. The travel speed will be set at 5 kph and the travel distance within the car park set to the car park perimeter for surface car parks with half the perimeter distance added for each floor above ground level for multi-storey car parks.

3.4.3 Consideration will be given to the inclusion of places where vehicles may stand with engines idling e.g. taxi stands (use design length of taxi ranks, number of vehicles, duration of stay etc.) and a separate calculation made for these emissions with EFT.

3.4.4 The EXEMPT model, available on the Defra website[8], will be used to estimate cold start emissions from car parks. Cold start emissions should be applied to vehicles which stay over two hours. If this information is not available, all vehicles should be assigned cold start emissions (using a length of stay of 600 minutes and an assumed ambient temperature of 10°C) as a worst case assessment. The "excess emissions" from the model will be calculated using half the driving distance within the car park (as estimated using the method in the previous paragraph) since cold start emissions will only be applicable to vehicles exiting the car park.

[6] http://laqm.defra.gov.uk/tools-monitoring-data/no-calculator.html
[7] http://dft.gov.uk/ha/standards/guidance/air-quality.htm
[8] http://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html#exempt

3.4.5 Car parks will be modelled as area sources at ground level for surface cars parks, as volume sources the height of the car park for multi-storey car parks, or as point sources at ventilation points for mechanically ventilated underground car parks (or at the entrance or openings of the car park if not mechanically ventilated) using emissions calculated for cold start and internal movement emissions uniformly distributed throughout the sources.

## 3.5 Background concentrations

3.5.1 Data for background concentrations will be taken from the maps available on the Defra website[9] or the Greater London Authority (GLA) pollution mapping[10] where more appropriate and from local monitoring information available in the area. Professional judgment will be used to determine which data is most appropriate to be used for the assessment of each area.

3.5.2 If local monitoring data is not available for the base year of 2012, it will be adjusted using the same factors for the area as those used in the Defra background maps. Local background monitoring data will also be adjusted, if used, for the two future assessment years of 2017 for construction and 2026 for operation of the Proposed Scheme.

## 3.6 Speeds

3.6.1 Where data exist on actual speeds these will be used. In the absence of actual or modelling traffic speed data, the following speeds will be used (unless justified otherwise):

- 50% of the speed limit on central urban and or congested roads;
- 75% for urban but not congested roads;
- Roads within 50m and on junctions (including roundabouts) should have their speeds adjusted as advised by LAQM.TG(09).;
- Signalled junctions = 15kph;
- Small roundabouts (total roundabout length <150m) = 20kph;
- Large roundabouts (total roundabout length >150m) = 30kp; and
- Roads within 50m of roundabouts with traffic lights = 15kph.

## 3.7 Baseline verification traffic

3.7.1 An existing baseline year of traffic data will be utilised for the study area. A full assessment of the entire study area will not be required, however, this information will be used to test model performance and undertake model verification in line with guidance in the LAQM.TG(09).

[9] Defra; 2010 based background maps for NOx, NO2, PM10 and PM2.5; http://laqm.defra.gov.uk/maps/maps2010.html; Accessed: July 2013
[10] Greater London Authority; London Atmospheric Emissions Inventory 2008 Concentration Maps; http://data.london.gov.uk/laei-2008-concentration-maps; Accessed: May 2013.

## 3.8 Construction traffic

3.8.1 Traffic data will be utilised for a hybrid year during construction – essentially this will be the worst case traffic data for each location. The construction impact assessment will be carried out with a year of assessment of 2017.

## 3.9 Operational traffic

3.9.1 Only opening year operational traffic (2026) will be assessed for local air quality. A 'without the Proposed Scheme' scenario and a 'with the Proposed Scheme' scenario will be assessed and compared. A Baseline scenario will be assessed for information purposes.

# 4 Construction assessment

4.1.1 In addition to a construction traffic assessment, the construction assessment will follow the IAQM Dust Guidance 2012 methodology[11].

4.1.2 The scale of non-road mobile and non-road machinery emissions will be considered in the assessment. It is expected that these emissions are likely to be very low in relation to other sources in the area and will not require a quantitative assessment but this will be confirmed..

## 4.2 Mitigation measures

4.2.1 When undertaking the construction impact assessment the mitigation measures detailed within the draft Code of Construction Practice (see Volume 5: Appendix CT-003-000) will be applied.

## 4.3 Limitations

4.3.1 Non-scheme car park emissions will not be assessed unless professional judgement indicates that they may contribute significantly to the outcome and have not been included in the baseline.

4.3.2 On-road cold start emissions associated with car parks and the developments have not been assessed although these will have a very small effect on the emissions from the local road network.

4.3.3 Emissions from rail brake and track wear during operation are assumed to be negligible and should not be included in the assessment.

4.3.4 Trains and much of the Proposed Scheme infrastructure will be electrically operated however emissions from power plants used to power the trains and infrastructure have not been assessed as this is outside the scope of a local air quality assessment.

[11] IAQM (2011), *Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance.*

# Annex B: Community – technical note

1.1.1 The following technical note is appended to this document:

- Further assessment guidance

1.1.2 It should be noted that for the purpose of the technical notes, the topic areas of community and socio-economics have been combined.

# HS2 London-West Midlands

# Community and socio-economics

# Technical note – Further assessment guidance

## A report to HS2 Ltd by Arup/URS

# Contents



**List of tables**

# 1 Introduction

## 1.1 Introduction

1.1.1 This technical note provides further guidance on the assessment methodology for assessing potential community and socio-economic impacts and effects considered likely to arise from the construction and operation of the HS2 project.

1.1.2 The technical note builds upon and should be read alongside the HS2 Scope and Methodology Report (SMR see Volume 5: Appendix CT-001-000/1), Section 7: Community and Section 13: Socio-economics.

## 1.2 Community

1.2.1 Community effects are defined as non-economic effects upon people and organisations operating community facilities and will be considered against four principal types of infrastructure:

- residential property;
- community infrastructure;
- recreation infrastructure; and
- open and play space.

## 1.3 Socio-economics

1.3.1 The socio-economic assessment will identify impacts on businesses and organisations and effects on employment levels. It will consider the potential for the project to generate impacts and effects on:

- existing businesses and organisations;
- local economies, including employment; and
- planned growth and development.

1.3.2 The socio-economic assessment will provide inputs into the community assessment and draw upon other assessments where relevant, such as agriculture and soils.

## 1.4 Other environmental impacts

1.4.1 There are a number of other environmental topics, such as air quality, noise and vibration, visual, transport and climate that inform both the community and socio-economic assessments. An understanding of these methodologies and topics will be required to give context for potential in combination effects arising from impacts related to these topics.

## 1.5 Structure of guide

1.5.1 This technical note is structured as follows:

- Section 2 provides core definitions for the receptors and resources which are relevant in assessing potential community and socio-economic effects;

- Section 3 sets out further details of the community and socio-economic assessment criteria and guidance on how this will be applied.
- Section 4 provides a list of assumptions which have been applied to the community and socio-economic assessments.

# 2 Receptor and resource definitions

## 2.1 Introduction

2.1.1 Community resources and receptors are set out below against the infrastructure themes of residential property, recreational infrastructure; community infrastructure; open and play space.

## 2.2 Community resources and receptors

### Residential property

2.2.1 **Resources**: Residential property included:

- private, rented and shared ownership residential dwellings and their surrounding grounds/gardens;
- student accommodation;
- extra care/retirement housing;
- mobile homes where there is an established and recognised location for them to use, (e.g. barge moorings, caravan sites, traveller sites); and
- homes used in conjunction with a business or other function, for example, bed and breakfasts, farm houses and church rectories.

2.2.2 **Receptors**: includes the residents or tenants of properties. It also includes employees who permanently reside in a residential property, for example, care givers and janitors.

2.2.3 **Exclusions**: Residential health/social care facilities are covered under community infrastructure. Other community property will be considered under community infrastructure or recreation infrastructure. Travel accommodation such as hotels, bed and breakfasts and serviced apartment hotels will be included as businesses under the socio-economic assessment, except where the accommodation in question provides permanent residential dwelling for the owner/manager and/or staff when they are considered under community as well as socio-economic. Landlords or owners who do not reside in the property are also excluded.

2.2.4 Effects on the property market as a whole are considered under the socio-economic assessment.

### Community infrastructure

2.2.5 **Resources**: Community infrastructure includes:

- health and social care facilities including GP practices and health centres, hospitals, hospices, residential care facilities, sure start centres, social work centres, health-related emergency services, dentists;
- educational facilities including day nurseries, primary schools, secondary schools, colleges, universities, other organised learning environments and education resource centres;

- community centres, youth centres, and other relevant facilities used for local community meetings and activities;
- institutional uses defined as government local authority and emergency services open to the public;
- local high streets and local centres which provide local services including convenience retail and services such as post offices and hairdressers; and
- places of worship (with some potential overlap with open space, e.g. burial grounds, cemeteries).

2.2.6 **Receptors**: users and beneficiaries of resources which include local residents, organised (community) groups, pupils, patients, congregations and employees who used community infrastructure. Receptors also include owners and organisations running the resources.

2.2.7 **Exclusions:** employment impacts will be covered under the socio-economic assessment.

## Open space and play space

2.2.8 **Resources**: open space including areas of land and water (such as rivers, canals, lakes and reservoirs) which offer opportunities for sport and recreation and could also act as a visual amenity.

2.2.9 Open spaces include publicly accessible spaces and open space that is visible from places where people have regular access.

2.2.10 The following typology illustrates the broad range of open space resources that may be of public value, including play spaces:

- parks and gardens – includes urban parks, country parks and formal gardens;
- accessible countryside in urban fringe areas;
- wider countryside;
- natural and semi-natural urban green spaces – includes woodlands, urban forestry, scrub, grasslands (e.g. downlands, commons and meadows), wetlands, open and running water, wastelands and derelict open land and rock areas (e.g. cliffs, quarries and pits);
- green corridors – includes river and canal banks, recreational (off road) cycle routes, bridleway, and promoted recreational walking routes;
- outdoor sports facilities (with natural or artificial surfaces and either publicly or privately owned) – includes tennis courts, bowling greens, sports pitches, golf courses, athletics tracks, school and other institutional playing fields;
- amenity green space (most commonly, but not exclusively in housing areas) – includes informal recreation spaces, green spaces in and around housing, and village greens;
- allotments, community gardens, and city (urban) farms;

- cemeteries and churchyards;
- civic spaces, included civic and market squares, and other hard surfaced areas designed for pedestrians; and
- outdoor play spaces included provision for children and teenagers – including play areas, skateboard parks, outdoor basketball hoops, and other more informal areas.

2.2.11 **Receptors**: users and beneficiaries of resources which include local residents, organised (community) groups, pupils, patients, congregations and employees who use community infrastructure. Receptors also include owners and organisations running the resources.

2.2.12 **Exclusions**: employment impacts will be covered under the socio-economic assessment.

## Recreational infrastructure

2.2.13 **Resources**: recreation infrastructure related to public and commercial recreational facilities where not covered under open space and play space. Recreation infrastructure includes:

- sports centres and facilities, leisure centres and fitness clubs. (Some recreation facilities may include both indoor and outdoor recreation facilities, e.g. golf clubs, paintballing);
- stadia, arena and professional sports clubs which host games and events open to the public;
- indoor (publicly owned and commercial) children's play areas;
- museums, art galleries, theatres, cinemas, historic buildings and stately homes open to the public, other cultural venues and facilities;
- food venues, cafes, restaurants;
- music venues, bars, pubs, night clubs, social clubs (e.g. Irish clubs, Conservative clubs, Labour clubs, Working Men's clubs); and
- other recreational facilities, for example, theme parks, animal sanctuaries, zoos, aquariums, visitor centres, camp sites, equestrian facilities.

2.2.14 **Receptors**: users and beneficiaries of resources which include local residents, organised (community) groups, pupils, patients and employees who used recreation infrastructure. Receptors also include owners and organisations that ran the resources.

2.2.15 **Exclusions**: outdoor and open spaces used for recreation which are already covered under open space, e.g. a public bridleway used for horse riding. Employment impacts will be covered under the socio-economic assessment.

## 2.3 Socio-economic resources and receptors

2.3.1 Socio-economic resources and receptors are set out below covering the themes of construction, operation and wider development effects.

### Resources: property units

2.3.2 All property units considered to be physically affected by project proposals supporting the employment of persons.

2.3.3 Property units include identifiable land and property including:

- commercial offices;
- warehousing;
- retail;
- open land storage;
- partial covered land storage;
- surface plant and machinery;
- land used for the production of agricultural produce (crops and/or livestock);
- land used for minerals extraction;
- Institutional uses (e.g. public administration, armed forces, police, regulatory bodies);
- community infrastructure, open space and play space and recreational infrastructure where they have employment and/or economic characteristics; and
- communal residential establishments (residential and nursing homes, dormitories).

### Resources: businesses

2.3.4 Businesses are considered to be all legal entities with definable establishments and employing persons within the impact area. A legal entity is considered to be:

- sole traders;
- partnerships;
- limited companies;
- public limited companies;
- social enterprises (including companies limited by guarantee, co-operatives, charitable trusts, community interest organisations);
- membership and representative bodies (political parties, professional associations, trade unions, unincorporated societies); and
- public services.

2.3.5 Businesses are considered to carry out a recognisable activity including any of the following from their establishment:

- agriculture, forestry and fishing;
- manufacturing;
- wholesale and retail trade;
- repair of motor vehicles and motorcycles;
- accommodation and food service activities;
- electricity, gas, steam and air conditioning supply;
- water supply, sewerage, waste management and remediation activities;
- construction;
- transportation and storage;
- information and communication;
- public administration and defence;
- compulsory social security;
- other service activities (excluding those covered under Community);
- financial and insurance activities;
- real estate activities;
- professional, scientific and technical activities;
- administrative and support service activities; and
- arts, entertainment and recreation.

2.3.6 The effect on agricultural businesses will be covered under the agriculture assessment and the results summarised in the socio-economic assessment together with other economic impacts.

## Receptors

2.3.7 Receptors include resident workers in employment associated with a resource including:

- employees in employment;
- sole traders; and
- partners.

## Exclusions

2.3.8 Businesses concerned with health and social care and education and other service delivery activity play a dual role in the assessment in so far as they provide services to people as individuals as well as performing a role as an employing business. Impacts

on the delivery of services to people and amenity impacts on employees and organisations are considered under the community assessment whilst impacts on employment will fall under the remit of the socio-economic assessment.

2.3.9 Property units that support embedded infrastructure such as pipe line networks, digital communications or utility network connections infrastructure are not considered to support employment in a direct sense rather this was a matter for consideration in relation to service diversions/relocations.

2.3.10 For the purposes of assessing the impacts on home based businesses, all such businesses are considered to be ancillary to the main use as a residence (unless separately rated). The loss of residences will be captured under the requirements dealt with under the community assessment. Businesses operated as an ancillary activity will be considered to follow the relocation of any affected household.

2.3.11 Businesses without employment include companies registered to an address or companies remotely operating physical assets e.g. sub-let premises. The latter include owners of tenanted properties e.g. buy to let landlords or institutional owners. In these instances, the impacts affecting occupiers as individuals will be assessed under community impacts.

2.3.12 Businesses operating in the informal economy may be encountered. Businesses who have no formal title to land/property used in pursuit of a business activity are presumed to lie outside scope e.g. car repairs operated from a residential garage.

# 3 Community and socio-economic assessment criteria

## 3.1 Introduction

3.1.1 The ES uses both the terms 'impact' and 'effect' in all environmental topics. Whilst the nature of the difference of the topics means that the terms are likely to be used slightly differently in each, conformity of approach should be sought. An impact will be generally considered to be a physical change caused by the scheme (and in this context changes in air quality, noise levels or the quality of a view for example will be 'impacts'). The consequences of impacts on the receptors will be generally termed effects.

3.1.2 For the community and socio-economic assessments, resources will be the assets and facilities which are affected. Receptors are the operators, users or beneficiaries of those resources. Resources and receptors will vary for each type of impact and effect. So for example, the impact of 'increased construction traffic' may have a range of impacts, such as congestion on the roads. The effects of this congestion could be disturbance and annoyance to local residents and disruption for local businesses.

## 3.2 Impacts and effects

3.2.1 Impacts relevant to the community and socio-economic assessments fall broadly within the following categories:

- demolition and direct land possession;
- damage to property as a result of construction;
- intrusion/disturbance to communities, businesses and community facilities caused by other environmental impacts; and
- the economic consequences for local economies and their communities, for example via multiplier mechanisms[1].

3.2.2 Impacts will generate the following broadly defined effects on receptors and resources:

- **loss or gain**: a loss or gain to a resource or receptor. For example a decrease in housing stock as a result of demolitions, an increase in employment opportunities as a result of construction;
- **displacement**: displacement means the re-location of receptors from one location to another location within the study area, for example people moving from their homes to replacement homes, or businesses moving from their premises. The assessment recognises that in some cases businesses may expire if they are forced to relocate, and some businesses/residents may relocate outside of the study area (referred to as leakage);

[1] Multiplier mechanisms could include indirect employment opportunities generated as a result of construction and operation of the Proposed Scheme.

- **change in amenity**: The benefits of enjoyment and wellbeing that receptors gain from a resource in line with its intended function. This is referred to as an amenity value. The amenity value that receptors give to resources could be affected by a combination of factors such as: noise and vibration; heavy goods vehicle (HGV) construction traffic; air quality; and visual impacts. The socio-economic assessment will consider when a change in receptor amenity could potentially result in a loss of trade for affected businesses; and
- **isolation**: In the context of this assessment, isolation will be measured by potential isolation and islanding of communities and businesses. This includes physical and social barriers (i.e. non-economic) and the effects of this on local communities and businesses. The socio-economic assessment will consider when isolation of a business or group of businesses could potentially result in a loss of trade for those affected businesses.

## 3.3 Assessment criteria

3.3.1 Significance should be determined by assessing both the magnitude of the impact and the sensitivity of resources and receptors for each effect. Taken together magnitude and sensitivity will determine whether effects were considered to be 'significant' or 'not significant'. All effects are to be assessed, including adverse and beneficial.

3.3.2 There are several factors which determine magnitude of impact and sensitivity of resources and receptors. These factors and thresholds of significance vary for each theme of the community and socio-economic assessments.

3.3.3 The assessment criteria described in Table 1[2] highlight the types of impacts and effects on resources and relevant receptors. This includes guidance on the factors to consider and thresholds to ensure a consistent approach to assessing significance.

3.3.4 This table has been established using professional judgement and existing precedents and should be used as the starting point for assessment. In some instances it may be considered appropriate to adjust sensitivity and magnitude in the light of specific circumstances.

3.3.5 Table 1 will be used to determine both construction phase effects and operational phase effects. Whether a particular resource and receptor needs separate assessment for the construction and operational phases will depend upon the specifics of the scheme. Some receptors need different assessments for both construction and operational phases while other receptors will only require an assessment for one of the phases. There will also be instances in which it will be appropriate to take into account the construction phase effects when carrying out the assessment of the operational phase, for example if a facility will be closed down during the construction phase and would only be partly reopened during the operational phase.

[2] Table 1 builds upon the assessment guidance set out in the HS2 Scope and Methodology Report Chapters 7: Community and Chapter 14: Socio-economics.

Table 1: Guidance on assessing sensitivity and magnitude

(boxes in yellow are community impacts/effects, boxes in orange are socio-economic impacts/effects)

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| 1. Residential Property | 1.1 Residential property (including gardens) lost in part or whole to land required for construction or operation of the Proposed Scheme | Reduction in housing stock available for people | Displacement of home owners/ tenants, inconvenience and loss of their assets | • HIGH:<br>– Permanent loss (> months) of 25 residential units or more<br>– Temporary displacement (< 3 months) of 50 residential units or more<br>• MEDIUM:<br>– Permanent loss (> 3 months) of 10 residential units or more<br>– Temporary displacement (< 3 months) of 20 residential units or more<br>• LOW[3]:<br>– Permanent loss (> 3 months) of 5 residential units or more<br>– Temporary loss (< 3 months) of 10 residential units or more<br>• NEGLIGIBLE:<br>– Permanent loss (> 3 months) of 4 residential units or less<br>– Temporary displacement (< 3 months) of 9 residential units or less<br>– Possible variations: Where the number of dwellings affected is a high proportion of the size of a local community it may be appropriate to adjust the magnitude of impact | • HIGH<br>Possible variations:<br>– Residents who only live for short periods of time in the properties (e.g. student accommodation) will experience less/limited disruption and so it may be appropriate to reduce sensitivity. |
| | 1.2 Amenity value of residential property is changed | Character or quality of residential properties changes | Receptors' of resource is changed | At least five properties need to experience an effect for a resource to potentially experience a community impact. The primary test of magnitude will be the nature of the effects on the function of the resource. Also of relevance is the duration of the impact. | • HIGH<br>Given the likely fairly small range in the number of units making up an individual receptor it is not anticipated to be relevant to vary the |

[3] The low impact quantities will be the same as used for the Crossrail threshold of significance. When combined with the usual high sensitivity of the residential receptor this also will give a significant impact for HS2 receptors.

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| | | | | **Effect on function** of resource and implications for receptors:<br>• HIGH: Three or more residual significant other effects<br>• MEDIUM: Two significant residual other environmental effects<br>The amenity assessment will only consider the in-combination significant residual effects from other topics so the LOW and NEGLIGIBLE categories are not considered to be applicable with regards to magnitude of impact.<br>Potentially other topic effects[4] could include relevant elements of: air quality; landscape and visual; sound, noise and vibration; and traffic and transport (in terms of impacts of HGV (construction traffic) movements[5]).<br>**Duration**: The duration of the impact should be taken into account. Generally speaking where duration is less than six months it may be appropriate to reduce the magnitude of the impact below the initial effect thresholds. | magnitude by the number of units. |
| | 1.3 Isolation of residential properties from other properties and infrastructure[6] | Physical e.g. islanding or isolation of resource | Social and/or community functioning is damaged | At least five properties need to experience an effect for a resource to potentially experience a community impact.<br>• HIGH:<br>– Permanent isolation (>12 months) of residences from their communities and services covering many of the other properties and/or much of the infrastructure that they typically connect with/access on an at least weekly basis. Occurs as a result of either road closure and/or lengthy delay/disruption to journeys on at least a weekly basis. Can also occur as a visual barrier due to construction works surrounding residential dwellings.<br>– Temporary isolation (6 to 12 months) of residences from their communities and services covering many of the other properties and/or much of the infrastructure that they typically connect with/access on an at least daily basis. Occurs as a result of either road closure | • HIGH:<br>– No comparable and accessible alternatives exist within the relevant catchment area<br>– Resources/receptors have no or very little ability to absorb the change<br>– With a high proportion of more vulnerable user groups, e.g., children, elderly, disabled.<br>• MEDIUM:<br>– Limited comparable and accessible alternatives exist within the relevant catchment area<br>– Resources/receptors have limited ability to |

[4] Some of the other Topics will not assess all community resources potentially susceptible to amenity impacts. For the community resources which fall into this category, the community assessor should liaise with the relevant Topic Lead who can provide expert judgement on whether there is likely to be a residual significant effect.
[5] The HGV (construction traffic) movements' assessment assesses routes to be used by HGV construction traffic which will be significantly affected by the Proposed Scheme. Assessors should identify and map community resources whose sensitivity is considered susceptible to HGV construction traffic flows.
[6] This type of impact is different from the severance impacts assessed in Traffic and Transport, which are focused solely on impacts on journeys.

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| | | | | and/or lengthy delay/disruption to journeys on at least a daily basis. Can also occur as a visual barrier due to construction works surrounding residential dwellings.<br>• MEDIUM:<br>– Permanent isolation (> 12 months) of residences from their communities and services leaving them partially isolated from some of the other properties and/or infrastructure that they typically connect with/access on an at least a weekly basis. Occurs as a result of either road closure and/or moderate delay/disruption to journeys on at least a weekly basis. Can also occur as a visual barrier due to construction works surrounding residential dwellings.<br>– Temporary isolation (6-12 months) of residences from their communities and services leaving them mostly isolated from some of the other properties/infrastructure that they typically connect with/access on a weekly basis. Occurs as a result of road closure or moderate delay/disruption to journeys on a weekly basis. Can also occur as a visual barrier due to construction works surrounding residential dwellings.<br>– Temporary isolation (1 to 6 months) of residences from their communities and services leaving them mostly isolated from some of the other properties and/or infrastructure that they typically access on a daily basis. Occurs as a result of road closure or moderate delay/disruption to journeys on at least a daily basis. Can also occur as a visual barrier due to construction works surrounding residential dwellings.<br>• LOW:<br>– Permanent isolation (> 12 months) of residences from their communities and services from a small number of the other properties and/or amount of infrastructure that they typically connect with/access on a weekly (or less frequent) basis. Occurs as a result of either road closure or minor delay/disruption to journeys.<br>– Temporary isolation (1-12 months) of residences from their communities and services leaving them partially isolated from a small number of the other properties | absorb the change<br>– With a mix of user groups<br>• LOW:<br>– Many comparable and accessible alternatives exist within the relevant catchment area<br>– Resources/receptors has sufficient means and capacity to absorb the change<br>– A narrow population of users with no specific vulnerable groups where access is a key issue; or a general mix of users |

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| | | | | and/or amount of infrastructure that they typically connect with/access on a weekly (or less frequent) basis. Occurs as a result of either road closure or minor delay/disruption to journeys. Can also occur as a visual barrier due to construction works surrounding residential dwellings.<br>– Temporary isolation (< 1 month) of residences from their communities and services partially isolated from a small number of the other properties and/or infrastructure that they typically access on a weekly (or less frequent) basis. Occurs as a result of road closure or minor delay/disruption to journeys. Can also occur as a visual barrier due to construction works surrounding residential dwellings.<br>• NEGLIGIBLE:<br>– No permanent isolation (> 12 months) of any residences from their communities and services from the other properties and/or infrastructure that they typically connect with or access on an infrequent basis. There may be short delay/disruption to routes to access services. Can also occur as a visual barrier due to construction works surrounding residential dwellings.<br>– Temporary isolation (1-12months) of any residential properties/communities from a small number of the other properties and/or infrastructure that they typically access on an infrequent basis. There may be short delay/disruption to routes to access services. Can also occur as a visual barrier due to construction works surrounding residential dwellings.<br>– Temporary isolation (< 1 month) of any residential properties/communities from a small number of the other properties and/or infrastructure that they typically access on an infrequent basis. There may be short delay/disruption to access services. Can also occur as a visual barrier due to construction works surrounding residential dwellings.<br>Possible variations: Where the number of dwellings affected is a high proportion of the size of a local community it may be appropriate to adjust the | |

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| | | | | magnitude of impact.<br><br>Assessors should review Traffic and Transport assessments of severance and journey delays to check for consistency with findings. These assessments are anticipated to be helpful for context and issues. | |
| 2. Community infrastructure, recreation infrastructure and open/play space | 2.1 Infrastructure lost due to land required for construction or operation of the Proposed Scheme in part or in whole | Decline in facilities available for community use or temporary impairment of use | Loss of facilities and benefits for users, workers owners, and groups/ organisations, including any differential equality and health effects | Below are details of characteristics (function and duration) typically associated with each magnitude of impact. Depending on the nature of the impact the weight given by the assessor to each characteristic will vary so that it is not necessary that the assessed degree of impact includes all of the characteristic thresholds given under each magnitude.<br><br>• HIGH:<br>– Function/ability to absorb: Resource is completely closed/compromised and unusable for its intended purpose(s)Duration: Long term (>1 year)/permanent<br><br>• MEDIUM:<br>– Function/ability to absorb: Resource is partially closed/compromised and unusable for a proportion of its intended purposes<br>– Duration: Medium term (6 months to 12 months)<br><br>• LOW:<br>– Function/ability to absorb: Resource is compromised and its functionality is partly impaired or compromised Duration: Short term (1 month to 6 months) and reversible<br><br>• NEGLIGIBLE:<br>– Function/ability to absorb: Resource is not closed and can continue to be used for its intended purpose without any significant inconvenience or detriment to the users<br>– Duration: Short term (<1 month and fully reversible) | Below are details of characteristics typically associated with each sensitivity of impact.<br><br>• HIGH:<br>– No comparable and accessible alternatives exist within the relevant catchment area<br>– Highly or regularly used and valued resource<br><br>• MEDIUM:<br>– Limited comparable and accessible alternatives exist within the relevant catchment area<br>– Moderately or semi-regularly used and valued resource<br><br>• LOW:<br>– Many comparable and accessible alternatives exist within the relevant catchment area<br>– Sparingly or infrequently used and valued resource<br><br>Possible variations: It may be appropriate to vary sensitivity if receptors have limited ability to absorb change |
| | 2.2 Amenity value of infrastructure is changed | Character or quality of cities/towns/ neighbourhoods/ paths changes. | Receptors' enjoyment of resource is changed, including any differential equality and health | The primary test of magnitude will be the nature of the effects on the function of the resource. Also of relevance is the duration of the impact.<br><br>Effect on function of resource and implications for | Below are details of characteristics typically associated with each sensitivity of impact.<br><br>• HIGH:<br>– There are limited/no comparable and |

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| | | | effects | receptors:<br>• HIGH: Three or more residual significant other effects<br>• MEDIUM: Two significant residual other environmental effects<br>The amenity assessment will only consider the in-combination significant residual effects from other Topics so the LOW and NEGLIGIBLE categories are not considered to be applicable with regards to magnitude of impact.<br>Potentially other topic effects could include relevant elements of: air quality; landscape and visual; sound, noise and vibration; and traffic and transport (in terms of impacts of HGV (construction traffic) movements.<br>**Duration**: The duration of the impact should be taken in to account. Generally speaking where duration is less than 6 months it may be appropriate to reduce the magnitude of the impact below the initial effect thresholds. | accessible alternatives that exist within the relevant catchment area<br>– Resource/receptor has limited ability to absorb the change (e.g. this may be applicable for quiet gardens, quiet/solitary natural beauty spots, etc.)<br>– Highly or regularly used and valued resource<br>• MEDIUM:<br>– There are limited comparable and accessible alternatives within the relevant catchment area<br>– Resources/receptors have limited ability to absorb the change.<br>– Moderately or semi-regularly used and valued resource<br>• LOW:<br>– Resource/receptor are able to relatively easily absorb the change (e.g. this may be applicable for active recreational sports fields and grounds and open spaces)<br>– There are many comparable and accessible alternatives exist within the relevant catchment area.<br>– Sparingly or infrequently used and valued resource |
| | 2.3 Isolation of community infrastructure from other properties and infrastructure[7] Isolation of community infrastructure | Physical e.g. Islanding or isolation of resource | Social and/or community functioning is damaged | • HIGH:<br>– Permanent isolation (>12 months) of services from its community covering much of the relevant local community that it typically serves on at least a weekly basis. Occurs as a result of either road closure and/or lengthy delay/disruption to journeys on at least a weekly basis. Can also occur as a visual barrier due to construction works surrounding community | • HIGH:<br>– No comparable and accessible alternatives exist within the relevant catchment area<br>– Resources/receptors have limited ability to absorb the change<br>– With a high proportion of more vulnerable user groups, e.g., children, elderly, disabled |

[7] This type of impact is different to the severance impacts assessed in Traffic and Transport, which are focused solely on impacts on journeys.

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| | | | | infrastructure.<br>– Temporary isolation (6 to 12 months) of services from its community covering much of the relevant local community that it typically serves on at least a daily basis. Occurs as a result of either road closure and/or lengthy delay/disruption to journeys on at least a daily basis. Can also occur as a visual barrier due to construction works surrounding community infrastructure.<br>• MEDIUM:<br>– Permanent isolation (> 12 months) of services from its community leaving it partially isolated from some of the relevant local community that it typically serves on at least a weekly basis. Occurs as a result of either road closure and/or moderate delay/disruption to journeys on at least a weekly basis. Can also occur as a visual barrier due to construction works surrounding community infrastructure.<br>– Temporary isolation (6-12 months) of services from its community leaving it mostly isolated from some of the relevant local community that it typically serves on at least a weekly basis. Occurs as a result of road closure or moderate delay/disruption to journeys on an at least a weekly basis. Can also occur as a visual barrier due to construction works surrounding community infrastructure.<br>– Temporary isolation (1 to 6 months) of services from its community leaving it mostly isolated from some of the relevant local community that it typically serves on at least a daily basis. Occurs as a result of road closure or moderate delay/disruption to journeys on at least a daily basis. Can also occur as a visual barrier due to construction works surrounding community infrastructure.<br>• LOW:<br>– Permanent isolation (> 12 months) of services from its community leaving it partially isolated from a small part of the relevant local community that it typically serves on a weekly (or less frequent) basis. Occurs as a result of either road closure or minor delay/disruption | • MEDIUM:<br>– Limited comparable and accessible alternatives exist within the relevant catchment area<br>– Resources/receptors have limited ability to absorb the change<br>– With a mix of user groups<br>• LOW:<br>– Many comparable and accessible alternatives exist within the relevant catchment area<br>– Resource/receptor are able to relatively easily absorb the change<br>– A narrow population of users with no specific vulnerable groups where access is a key issue; or a general mix of users |

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| | | | | to journeys. Can also occur as a visual barrier due to construction works surrounding community infrastructure.<br>– Temporary isolation (1-12 months) of services from its community leaving it partially isolated from some of the relevant local community that it typically serves on a weekly (or less frequent) basis. Occurs as a result of either road closure or minor delay/disruption to journeys. Can also occur as a visual barrier due to construction works surrounding community infrastructure.<br>– Temporary isolation (< 1 month) of services from its community leaving it partially isolated from some of the relevant local community that it typically serves on a weekly (or less frequent) basis. Occurs as a result of either road closure or minor delay/disruption to journeys. Can also occur as a visual barrier due to construction works surrounding community infrastructure.<br>• NEGLIGIBLE:<br>– No permanent isolation (> 12 months) of services from its community that it typically serves on an infrequent basis. There may be short delay/ disruption to routes to access services. Can also occur as a visual barrier due to construction works surrounding community infrastructure.<br>– Temporary isolation (1-12months) of services from its community that it typically serves on an infrequent basis. There may be short delay/ disruption to routes to access services. Can also occur as a visual barrier due to construction works surrounding community infrastructure.<br>– Temporary isolation (< 1 month) of services from its community that it typically serves on an infrequent basis. There may be short delay/disruption to access services. Can also occur as a visual barrier due to construction works surrounding community infrastructure.<br>Possible variations: Where the number of users is a high proportion of the size of a local community it may be | |

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| | | | | appropriate to adjust the magnitude of impact<br><br>Assessors should review Traffic and Transport assessments of severance and journey delays to check for consistency with findings. These assessments are anticipated to be helpful for context and issues. | |
| 4. Existing businesses and organisations – due to land required for construct-ion or operation of the Proposed Scheme and amenity impacts | 4.1 Businesses (including community) lost due to land required for construction or operation of the Proposed Scheme | Loss or impairment of business activities | Change in employment and skills mix | Individual receptors:<br>• HIGH: Estimated loss/relocation of more than 50 jobs<br>• MEDIUM: Estimated loss/relocation of between 10 and 50 jobs<br>• LOW: Estimated loss/relocation of between 2 and 9 jobs<br>• NEGLIGIBLE: Loss/relocation of 1 or less jobs.<br>Possible variations:<br>• Where the number of employees is a high/low proportion of the size of a local community/business cluster it may be appropriate to increase/reduce the magnitude assessment.<br>Route wide:<br>• HIGH: Estimated loss/relocation of more than 5000 jobs<br>• MEDIUM: Estimated loss/relocation of between 1000 and 5000 jobs<br>• LOW: Estimated loss/relocation of between 100 and 999 jobs<br>• NEGLIGIBLE: Estimated loss/relocation of less than 100 jobs | Sensitivity will vary significantly and depend upon a range of factors:<br>• Availability of alternative, suitable premises<br>• Site specific issues<br>• Size of local labour market<br>• Skill levels and qualifications of local people; and<br>• Levels of unemployment<br>Assessors should use the question prompts in List B (refer to Section 3.4) when weighing up sensitivity. |
| | 4.2 Businesses (including community): Amenity value of infrastructure is changed resulting in an impact on businesses and organisations' operations | Character or quality of businesses and organisations' environment changes. | Change in employment and skills mix | The primary test of magnitude will be the nature of the effects on the function of the resource. Also of relevance is the duration of the impact.<br><br>Magnitude of impact is anticipated to vary significantly depending upon the characteristics of each situation. Generally though the magnitude of socio-economic impacts will depend upon the magnitude of other environmental impacts. The following guide is consequently suggested at the receptor level:<br><br>Effect on function of resource and implications for | Sensitivity will vary significantly depending upon a wide range of characteristics of each business/organisation. Generally more sensitive receptors are likely to fall in sectors including:<br>• Hospitality<br>• Recreation and culture<br>• Retail<br>• Education and training.<br>Assessors should use the question prompts in |

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| | | | | receptors:<br>• HIGH: Three or more residual significant other effects<br>• MEDIUM: Two significant residual other environmental effects<br>The amenity assessment will only consider the in-combination significant residual effects from other Topics so the LOW and NEGLIGIBLE categories are not considered to be applicable with regards to magnitude of impact.<br>Potentially other effects include relevant elements of: air quality; landscape and visual; sound, noise and vibration; and traffic and transport (in terms of impacts of HGV (construction traffic) movements.<br>**Duration**: The duration of the impact should be taken in to account. Generally speaking where duration is less than 6 months it may be appropriate to reduce the magnitude of the impact below the initial effect thresholds.<br>Given the uncertainties of estimating such employment losses/relocations at an individual receptor level the individual assessments will be used as an input to estimate an aggregated route-wide level impact[8]:<br>• HIGH: Estimated loss/relocation of more than 500 jobs<br>• MEDIUM: Estimated loss/relocation of between 100 and 500 jobs<br>• LOW: Estimated loss/relocation of between 10 and 99 jobs.<br>• NEGLIGIBLE: Estimated loss/relocation of less than 10 jobs. | List B (refer to Section 3.4) when weighing up sensitivity. |
| | 4.3 Isolation of infrastructure from receptors resulting in an impact on businesses and organisations' | Physical e.g. Islanding or isolation of resource results in change to business and organisations' | Change in employment and skills mix | Magnitude of Impact will vary depending upon a number of factors including:<br>• Closures of roads/PRoW and duration of closures<br>• Extent of diversions<br>• Potential delay/disruption | Sensitivity will vary significantly depending upon a wide range of characteristics of each business/organisation. Generally more sensitive receptors are likely to fall in sectors including:<br>• Hospitality<br>• Recreation and culture |

[8] Establishments which will be significantly affected by amenity and/or isolation should be converted to an employment total using available information (e.g. business type and estimated employment within business establishment). This information will be presented in the Route Wide Assessment (Volume 3).

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| | operations | environment | | Assessors should use the question prompts in List A (refer to Section 3.4) when weighing up magnitude.<br>Given the uncertainties of estimating such employment losses/relocations at an individual receptor level the individual assessments will be used as an input to estimate an aggregated route-wide level impact:<br>Route wide:<br>• HIGH: Estimated loss/relocation of more than 500 jobs<br>• MEDIUM: Estimated loss/relocation of between 100 and 500 jobs<br>• LOW: Estimated loss/relocation of between 10 and 99 jobs<br>• NEGLIGIBLE: Estimated loss/relocation of less than 10 jobs | • Retail<br>• Education and training.<br>Assessors should use the question prompts in List B (refer to Section 3.4) when weighing up sensitivity. |
| 5. Employment associated with construction | 5.1 Direct employment opportunities associated with the construction phase | Demand for construction phase services | Demand for construction phase associated jobs and change in opportunities for local employment | Route wide:<br>• HIGH: Estimated creation of more than 10,000 person years[9] of construction employment<br>• MEDIUM: Estimated creation of between 5,000 and 10,000 person years of construction employment<br>• LOW: Estimated creation of between 100 and 4,999 person years of construction employment<br>• NEGLIGIBLE: Estimated creation of less than 100 person years of construction employment | Sensitivity in this context is taken to cover the benefit that individuals will derive from employment and this is assumed to be significant. Consequently sensitivity is usually assessed to be:<br>• HIGH |
| | 5.2 Indirect impacts on the economy of the construction phase | Indirect impacts on other construction sector projects, multiplier impacts on the wider economy | Demand for construction sector jobs and change in opportunities for local employment | Route wide:<br>• HIGH: Estimated creation of more than 10,000 person years of construction employment<br>• MEDIUM: Estimated creation of between 5,000 and 10,000 person years of construction employment<br>• LOW: Estimated creation of between 100 and 4,999 person years of construction employment<br>• NEGLIGIBLE: Estimated creation of less than 100 person years of construction employment | Sensitivity in this context is taken to cover the benefit that individuals will derive from employment and this is assumed to be significant. Consequently sensitivity is usually assessed to be:<br>• HIGH |

[9] Construction labour is reported in construction person years, where one construction person year represents the work done by one person in a year composed of a standard number of working days.

| Theme | Impacts | Effects: | | Magnitude of impact | Sensitivity of receptors/resources |
|---|---|---|---|---|---|
| | | On resources | On receptors | | |
| 6. Employment associated with operations | 6.1 Direct employment opportunities associated with the operations phase | Demand for operational phase services | Change in employment and skills and change in opportunities for local employment | Route wide:<br>• HIGH: Estimated net creation of more than 5,000 jobs over baseline<br>• MEDIUM: Estimated net creation of between 1,000 and 5,000 jobs over baseline<br>• LOW: Estimated net creation of between 100 and 999 jobs over baseline<br>• NEGLIGIBLE: Estimated net creation of less than 100 jobs over baseline | Sensitivity in this context is taken to cover the benefit that individuals will derive from employment and this is assumed to be significant. Consequently sensitivity is usually assessed to be:<br>• HIGH |
| | 6.2 Indirect impacts on the economy of the operations phase | Indirect impacts on sectors of the economy, multiplier impacts on the wider economy | Change in employment and skills and change in opportunities for local employment | Route wide:<br>• HIGH: Estimated net creation of more than 5,000 jobs over baseline<br>• MEDIUM: Estimated net creation of between 1,000 and 5,000 jobs over baseline<br>• LOW: Estimated net creation of between 100 and 999 jobs over baseline<br>• NEGLIGIBLE: Estimated net creation of less than 100 jobs over baseline | Sensitivity in this context is taken to cover the benefit that individuals will derive from employment and this is assumed to be significant. Consequently sensitivity is usually assessed to be:<br>HIGH |

## 3.4 Assessment criteria checklist

### Magnitude of impact

3.4.1 In considering the magnitude of an impact on a resource and its receptors, assessors should consider each impact against the checklist of magnitude questions presented in List A. The questions are designed to assist in deciding on magnitude and judging whether there could be any specific circumstances in which the magnitude ranking should differ from the thresholds. Not every question will be relevant to the circumstances.

3.4.2 Some situations/outcomes may not be known for certain. Assessors should base their work on an assessed mostly likely situation/outcome.

#### *List A: Questions relevant to the assessment of magnitude of impact*

**Effect on function of resource and implications for receptors:**

- How will the impact affect the functioning of the resource? To what degree can it absorb the change?
- What is the severity/intensity of the impact on people's lives and activities?
  - Do other EIA topics conclude a significant effect?

**Duration – temporal scope of effect on receptor:**

- What is the temporal scope of the impact?
  - Does the impact occur at specific times of the day?
  - For how long does the impact occur?
  - How regularly does the impact occur?
  - Is the impact temporary or permanent?

### Sensitivity of receptors

3.4.3 In considering the sensitivity of receptors to an impact, assessors should consider each impact against the checklist of sensitivity questions given in List B. Not every question will be relevant to the circumstances of each receptor. The questions are designed to assist in deciding on sensitivity and judging whether there could be any specific circumstances in which the sensitivity ranking should differ from the thresholds.

3.4.4 Some situations/outcomes may not be known for certain. Assessors should base their work on assessed mostly likely situations/outcomes.

3.4.5 For the assessment of amenity impacts, sensitivity should be considered as a separate step in the community and socio-economic assessment process. Where there is an overlap with other disciplines and this is considered by assessors to be important they should ensure that the overall significance rating is consistent with the other relevant assessments.

### *List B: Questions relevant to the assessment of sensitivity*

#### Scarcity/alternatives for receptors

What is the scarcity of the affected resource and what is the availability of alternatives? Factors to consider include:

- What is the catchment area of the affected resource?
- Are there comparable alternative resources available within the relevant catchment area?
- How easy is it to replace the resource? E.g. does it have special site requirements that are difficult to replicate or are its locational requirements generic and relatively easily met elsewhere?
- What is the spare capacity of the alternative resources and is this potentially available to the users of the affected resource?
- What is the likelihood that alternative resources/sites/options will become available?

#### Capacity to respond to loss/gain for receptors

- What is the receptor's capacity to experience a loss or gain of the affected resource?
- Nature of users – are they concentrated in the local area? Are they a specialised interest group? Are they local/ regional/ national/ international? Does this nature then influence their capacity to experience a loss or gain in the affected resource?
- Are users concentrated in potentially more sensitive groups, such as people on low incomes, unemployed, older people, children, ethnic minorities, people in poor health etc.
- How mobile are the receptors? E.g. are they likely to have access to a car? Do they have any physical constraints on their movement such as walking slowly etc?

#### Number of people affected/extent of use/value of resource

What is the spatial scope of the effect (i.e. to help inform judgement on the number of people affected)?

- How many people/what proportion of people, are likely to experience the impact?
    - Generally the greater the number of people which experience an impact the greater the magnitude.
    - But also consider people experiencing an impact as a proportion of the total people in a relevant community and/or group, i.e. if the number of people experiencing an impact is low but the proportion is high, then it may be appropriate to consider the magnitude as higher.

## 3.5 Community wide effects

### Defining community-wide effects

3.5.1 There may be instances where a combination of effects on individual community resources has a wider impact on a community. Community assessors should consider whether the Proposed Scheme is likely to change the way in which a significant proportion of the people in a specific local community experience and performed their local functions (live, work, leisure, travel) on a day-to-day basis. Community-wide effects will be reported as 'cumulative effects' in the Formal Environmental Statement.

### Outline guidance

3.5.2 Using the individual assessments conducted at CFA level, community assessors should undertake a qualitative assessment of community-wide effects. This will require assessors to use professional judgement to consider whether the assessment findings on community resources and receptors in the CFA have identified matters that could be applicable/relevant at a community-wide level (i.e. having an appreciable effect across the majority of the community) as opposed to only affecting individually identified resources and receptors.

### Defining community geography

3.5.3 Assessment will either be undertaken at sub-CFA or CFA level. At sub-CFA level this will involve carrying out assessments at the level of smaller community areas. These smaller community areas would be typically aligned with obvious or clear spatial boundaries that separate or join-up geographic areas into distinct communities.

# 4 Community and Socio-economic Assumptions

## 4.1 Introduction

4.1.1 The key assumptions underlying the community and socio-economic assessments are set out below.

## 4.2 Community Assumptions

4.2.1 The assessment draws on other assessment topics where necessary to identify the primary sources of community impacts. Although the level and intensity of proposed construction will vary during the construction period, the assessment focusses on the construction activities and durations which could lead to the greatest potential impact.

4.2.2 The spatial scope of the assessment varies, depending on the nature of the receptors and the impacts being considered. Whilst effects associated with construction or the land used for construction/operation will be confined to the immediate vicinity of the route, effects resulting from a combination of impacts or relating to the overall functionality of a community will typically apply to wider areas such as neighbourhoods or parishes.

4.2.3 The community assessment considers the function of land rather than its ownership as the key parameter for assessing impacts associated with the Proposed Scheme.

4.2.4 The hybrid Bill identifies various categories of land required to facilitate the construction and operation of the Proposed Scheme. Some of these categories of land will have no impact on the ability of existing and future baseline uses of that land to continue both during construction and operation. For example, one category to which this applies is land above the line of tunnels.

4.2.5 Where practicable, land required solely during the construction period will be returned to its previous use after construction unless that use cannot continue or resume within a reduced area. Where the use cannot resume, the effect is treated as permanent.

4.2.6 The assessment considers the construction phase (2017-26) and the first year of operation (2026), with one exception. For the assessment of amenity effects, the operational noise assessment is based upon the service frequency associated with Phase two of the Proposed Scheme, which will not commence until some years later. For other assessment topics, it is generally assumed that effects are unlikely to persist for a long time into the future as communities adjust to the presence of the Proposed Scheme and as new or replacement community facilities will have been developed where necessary.

4.2.7 Community resources are mentioned expressly in the environmental baseline only where they contribute to the local context or where they may be affected by the Proposed Scheme. Consequently not all community resources within the study area are mentioned.

4.2.8 Effects relating to the severance of public rights of way (PRoWs) (public footpaths and bridleways) and highway and pedestrian diversions, are assessed under Traffic and

Transport. However, where PRoWs are a "promoted" destination in their own right as a recreational resource, they have been considered within the community assessment. Where impacts on open space and PRoWs are considered, these have been informed by open space and PRoW usage surveys.

4.2.9 Open space surveys were undertaken by community assessors in order to collect primary survey data on use of such spaces. Assessors surveyed each site on one week day during the autumn term and one summer weekend day. Surveying aimed to avoid adverse weather conditions and weather conditions were recorded for each survey. Any variations from the above and the reasons for this have been reported on in the individual open space survey write-ups in Volume 5 Community Appendices.

4.2.10 Where open space is privately owned and not available for use by the general public, it has been excluded from the assessment (e.g. woodlands on farmland). However, where land is privately owned but open for public use (e.g. parks or gardens surrounding country houses) it has been included in the assessment.

4.2.11 The community assessment reports on all significant community effects as well as those effects which are not significant but are considered of importance to reference given their relevance to the study area which represents each CFA.

4.2.12 The different assessments within the Community section (residential property and community infrastructure affected by land required for construction and operation of the Proposed Scheme, isolation and changes in amenity) are not directly comparable when considering significance of effect. Assessments have been considered in aggregate as part of the Community Wide analysis which is presented in the Community section (cumulatives section) in the CFA reports (ES Volume Two).

4.2.13 Isolation effects are included within the scope of this assessment and the analysis considers physical separation, major increases in delay/disruption (as identified in the Transport Assessment), and the psychological barrier effects (including those which may be caused by visual barriers, such as residential properties located amongst construction works) that might impair links between residents and their facilities. Isolation is assumed to be a phenomenon that will occur as a result of the construction of the Proposed Scheme and can be either a temporary or permanent effect.

4.2.14 The community amenity assessment draws on the residual significant effect findings from other topics (i.e. after mitigation has been taken into account by those topics) and combines these findings to determine whether there is a significant amenity effect on the community. Findings from other topic assessments are not directly comparable in terms of the specific scale of effect.

4.2.15 Increases in HGV construction traffic flows as a result of construction of the Proposed Scheme will affect the amenity of local communities. Community assessors obtained this information from the Transport Assessment. This aspect of the assessment is about the presence of HGV on routes and their proximity to community resources.

4.2.16 Information on duration of significant residual effects was provided by other topics where available. Where the relevant information was available, community assessors used this to identify when significant residual effects from other topics occurred simultaneously.

4.2.17 Professional judgement was provided by other topics (i.e. sound, noise and vibration (SNV), Landscape and Visual and Air Quality) to inform the community amenity assessment. Any significant effects findings established through professional judgement have been used in the same way as assessment findings derived through quantitative assessment.

4.2.18 The SNV Topic assumes all PRoW (with the exception of those that exist in tranquil areas) to be, by their nature, transitory routes with users not staying in any one location for a long period of time and hence have not included these PRoW within their assessment scope. Consequently, there are not considered to be any significant noise effects on PRoW (unless the assessment identifies significant SNV on areas prized for their tranquillity and hence the PRoW therein) as a result of construction and operation of the Proposed Scheme.

4.2.19 Commentary on noise impacting on recreational PRoW as a result of the Proposed Scheme was provided for those recreational PRoWs which run adjacent to the Proposed Scheme for at least 800m (this includes where the Proposed Scheme crosses the PRoW).

4.2.20 The assessment methodology excludes, for the purposes of reporting amenity and isolation effects, residential properties where the total number of dwellings is fewer than five. There are a number of individual properties scattered along the route where impacts may be experienced from other Topics. These impacts are assessed, where relevant, in other Topic chapters.

4.2.21 Residential properties which are impacted by the Proposed Scheme have been grouped together either by street, hamlet or village. In some circumstances along the route other Topics, such as SNV, may have grouped residential properties slightly differently. In these situations, community assessors liaise with the relevant Topic to determine professional judgement with regards to the residential grouping.

4.2.22 The community assessment considers three different types of cumulative effects. These are inter-project, in-combination (amenity) and community-wide (synergistic).

4.2.23 Community resources identified as part of inter-project (cumulative) schemes may interact with the Proposed Scheme during their construction and as a result of their occupation by new receptors during the time when the Proposed Scheme is being constructed and beyond. During their construction, cumulative projects have the potential to create their own environmental impacts. Additional SNV, visual, air quality, dust and HGV traffic movement impacts risk compounding those effects generated by the Proposed Scheme. However, given these projects are far into the future, a lack of information prevented any assessment of effect being undertaken.

## 4.3 Socio-economic Assumptions

4.3.1 The impacts of the Proposed Scheme on socio-economic resources (property units supporting employment ) and the consequential effects on receptors (users of the resource or it's service/goods) was considered in terms of full time equivalent (FTE) jobs gained, lost or relocated.

4.3.2 Loss of trade within a business can be considered as a loss of turnover and represented as a change in employment at the affected business (assuming a positive

relationship between growth/contraction in a business' turnover and growth/contraction in employment at that business).

4.3.3 Since the level and intensity of proposed construction will vary during the construction period, the level of significant effects on socio-economic resources could vary. The assessment reported is focused on the construction activities and durations which could lead to the greatest potential impact.

4.3.4 Where practicable, land required solely during the construction period will be returned to its previous use after construction unless that use cannot continue or resume within a reduced area. Where the use cannot resume, the effect is treated as permanent.

4.3.5 The assessment considers the construction phase (2017-26) and the first year of operation (2026). The first year of operation, 2026, was assessed as it was considered to offer a worse-case forecast of effects.

4.3.6 The future baseline of the construction phase was taken to be the existing employment position of those socio-economic resources identified as being directly affected or indirectly affected by the Proposed Scheme. It can be expected, due to changes in socio-economic conditions, that there would be changes in the number and type of business activities of those resources affected from that which is currently observed, for instance businesses may open or close, and sites or premises that are currently occupied may become unoccupied. However in absence of information about the specific economic circumstances of the businesses, their financial plans, owner intentions, or whether the capacity of the commercial site or building is likely to change in the long term, it is not possible to forecast how employment could change with any certainty before commencement of the Proposed Scheme.

4.3.7 The different assessments within the Socio-economic chapter (socio-economic resources affected by land required for the Proposed Scheme, isolation and changes in amenity) are not directly comparable when considering the significance of effect. For resources affected by land required for the Proposed Scheme the implication is that the employment within these resources will either relocate or be lost and the significance of this has been assessed. For resources affected by isolation and/or changes in amenity the situation is less clear in terms of employment implications. With this in mind impacts are assessed and reported at an individual resource level although any employment implications are assessed at route wide level.

4.3.8 The assessment considers the potential reduction in economic output arising as a consequence of direct effects – the relocation or closure of businesses located on land required for the construction and operation of the Proposed Scheme. For the purposes of this assessment the indicative rate of successful business relocations is judged to be 88% and no employment at these businesses will be lost. The rate of closure of directly affected businesses is therefore 12% and all employment within these businesses is assumed to be lost.

4.3.9 The socio-economic business amenity assessment draws on the residual significant effect findings from other Topics. These findings are combined to determine whether there is a significant amenity effect. Findings from other Topic assessments are not directly comparable in terms of their scale of effects.

4.3.10 The socio-economic business amenity assessment and community amenity assessment are not directly comparable. The business amenity assessment considers

whether a business may lose trade as a result of its users/customers amenity being affected by the Proposed Scheme and the potential employment consequences. The community amenity assessment considers whether the amenity that a community places on a community resource is affected by the Proposed Scheme.

4.3.11 Employment implications on individual socio-economic resources which result from single Topic significant residual effects are outside the scope of this assessment. At route wide level, any employment implications of this nature are considered to be limited and not significant.

4.3.12 The socio-economic assessment does not assess localised impacts on tourism/visitors to venues along the route. There is no robust evidence (or method of assessment) to determine whether or not there is a significant displacement of employment at these venues as a result of the Proposed Scheme.

4.3.13 With regards to the amenity and isolation assessments the sensitivity of receptors will vary from business to business but will be dependent on whether the Proposed Scheme will be likely to have an adverse effect on trade. Businesses located in the hospitality, recreation and culture and retail sectors are most likely to have receptors with high levels of sensitivity given the risk of trade diversion as a result of the Proposed Scheme. In determining sensitivity, consideration is given to catchment of the affected socio-economic resource, alternative unaffected competitor business, attraction of the facility to customers and type and make-up of facility.

4.3.14 With regards to the amenity and isolation assessments, it is assumed a business establishment experiencing an adverse effect on trade can adopt a number of strategies before reducing employment (e.g. cancel/postpone investment in premises/stock/machinery, reduce staff working hours, family members working longer hours, cancel/postpone plans to expand business, temporary laying-off staff, renegotiate loans or mortgage, increase marketing or advertising activity etc.). Any reduction in employment has been calculated by estimating the total employment of the business(es) affected; then, based on the business activity/sector type, by applying a percentage to represent the likely proportion of employment which could be significantly affected by changes in amenity or isolation.

4.3.15 Increases in HGV construction traffic flows as a result of construction of the Proposed Scheme will affect the amenity of local businesses and organisations. Socio-economic assessors obtained this information from the Transport Assessment. This aspect of the assessment is about the presence of HGV on routes and their proximity to socio-economic resources.

4.3.16 Information on duration of significant residual effects was provided by other Topics where available. Where the relevant information was available, socio-economic assessors used this to identify when significant residual effects from other topics occurred simultaneously.

4.3.17 Other Topics, such as SNV and Landscape and Visual, have not explicitly identified in their chapters all socio-economic resources which are significantly affected by the Proposed Scheme. In such cases, socio-economic assessors consulted with relevant Topics in order that they provided professional judgement on whether there were significant effects associated with those socio-economics resources which were not specifically identified in their chapters. For the purposes of business amenity

assessment, any significant effects findings which have been established through professional judgement were used in the same way as findings which had been derived by technical assessment and provided directly by the other Topics.

4.3.18 Magnitude of impact within the business amenity assessment is anticipated to vary significantly depending upon the characteristics of each situation. Generally the magnitude of impact will depend upon the magnitude of other environmental effects. However, in certain circumstances it was appropriate to acknowledge that some significant residual effects from other Topics (for example visual) may not be appropriate to apply to particular socio-economic resources in terms of contributing to a possible amenity loss.

4.3.19 Socio-economic resources identified as part of cumulative schemes may interact with the Proposed Scheme during their construction and as a result of their occupation by new receptors during the time when the Proposed Scheme is being constructed and beyond. During their construction, cumulative projects have the potential to create their own environmental impacts. Additional SNV, visual, air quality, dust and HGV traffic movement impacts risk compounding those effects generated by the Proposed Scheme. However, given these projects are far into the future, a lack of information prevented any assessment of effect being undertaken.

4.3.20 Employment within socio-economic resources was estimated through a combination of sources, for example, business consultation, Experian employment dataset, employment floor space (obtained from either the Valuation Office Agency or an estimate made via site visits and GIS mapping) and the Homes and Communities Agency (HCA) Employment Density Guide (2010). The estimate is calculated using standard employment density ratios and estimates of floor areas and may vary from actual employment at the sites.

4.3.21 Employment loss within agricultural organisations has been estimated by the Agriculture, forestry and soils topic and is reported in aggregate at route wide level in Volume Three.

4.3.22 Construction labour was reported in construction person years, where one construction person year represented the work done by one worker in a year composed of a standard number of working days.

4.3.23 It is assumed that the demand for and supply of construction labour will remain largely the same as at present up to the commencement of the Proposed Scheme. Employment effects associated with the construction phase of the Proposed Scheme are presented in gross and net terms, whereas operational employment of the Proposed Scheme is reported as gross; employment on the classic network is assumed to remain the same as present as released capacity is utilised by new services.

4.3.24 Additionality of the Proposed Scheme is defined as the impact that arises as a result of an intervention (in this case the Proposed Scheme) that would have not have occurred in the absence of that intervention.

4.3.25 The route wide additionality assumptions for the intervention case are set out in Table 2 and are based on rates set out in the English Partnerships Additionality guidance[10]:

Table 2: Proposed Scheme: Route wide additionality assumptions

| | **Effect Rate** | **Effect Level** |
|---|---|---|
| Leakage | 0% | None |
| Displacement | 25% | Low |
| Substitution | 0% | None |
| Multiplier | 1.5 | Medium |

4.3.26 Leakage: Impacts are considered at the UK level. Leakage for all types of impact is therefore assumed to be zero.

- Displacement refers to the potential change in economic output from businesses as a consequence of the Proposed Scheme. Displacement is estimated in relation to:
- Construction employment created by the Proposed Scheme: A low displacement is applied to reflect the uniqueness of the project and high demand for specialist, skilled workers, which will have a lower likelihood of displacing other construction projects or construction jobs over the relevant time period.
- The contraction in economic output as a consequence of employment losses at businesses directly affected (business relocations or closure) or indirectly affected (changes in amenity and isolation effects) during the construction phase is reflected by the resultant displacement effects on other parts of the economy: A low level of displacement was applied to employment identified as being potentially lost in these businesses to reflect the likelihood that these businesses operate in an established and competitive economy .
- The operational phase: During the operational phase it was not anticipated that operational jobs will supplant other economic activities from taking place, and therefore a low degree of displacement was assumed.
- Substitution: For all types of impact, zero substitution effects were assumed as employment created by the Proposed Scheme (during construction and operation) is not thought to be directly supported by initiatives which generate public sector assistance.
- Composite multiplier: The medium level composite multiplier is identified as being typical of the majority of public sector interventions.

[10] English Partnerships Additionality guidance.

# Annex C: Cultural heritage– technical notes

1.1.1 The following technical notes are appended to this document:

- Risk based approach to archaeological assessment
- Fieldwalking
- Geophysical survey

# HS2 London-West Midlands

# Cultural heritage

# Technical note – Risk based approach to archaeological assessment

## A report to HS2 Ltd by Arup/URS

# Contents



**List of tables**



**List of Appendices tables**

# 1 Introduction

1.1.1 This technical note outlines the cultural heritage environmental impact assessment (EIA) methodology which been developed for the Proposed Scheme.

1.1.2 A zone-based methodology for the assessment of archaeological risk for the EIA has been developed in conjunction with English Heritage (EH) and the Local Planning Authority (LPA) archaeological officers. This approach seeks to move beyond known 'point data' to look at the archaeological potential of the landscape as a whole, and recognises the possibility that there may be land access issues that limit the areas available for field evaluation survey work (either non-intrusive or intrusive).

1.1.3 The methodology identified in this technical note explicitly recognises that this zone-based approach relates solely to the EIA. However, this approach to risk assessment will provide a starting point for the future programme of archaeological investigation, and will help to ensure that this programme meets the National Planning Policy Framework (NPPF)[1] aim of increasing understanding of the historic environment.

1.1.4 Risk is defined, for the purposes of this methodology, as:

*Those areas of the project (within the land required for the construction or for the operation of the Proposed Scheme) where knowledge regarding the potential presence and/or characteristics of archaeological assets is insufficient to form a professional judgement as to their extent or significance (as defined in NPPF Annex 2: Glossary), or to understand the level of harm to that significance which might be anticipated.*

## 1.2 Objectives

1.2.1 The objectives of this methodology are to:

- provide a framework for the consistent consideration of archaeological risk within the context of the EIA process across the Proposed Scheme;
- enable reasoned professional judgements as to the likely presence/absence, nature and significance of buried archaeological assets, and to understand the level of impact to that asset which might be anticipated; and
- provide a mechanism that will focus the assessment on areas of the Proposed Scheme where there is considered to be archaeological risk.

## 1.3 Background

1.3.1 The traditional approach to assessment and decisions about where to undertake field evaluation tends to focus on known archaeological assets, thereby increasing our understanding of what we already know about. This can lead to overlooking locations and tracts of land where there is little information, either because there has been little development and therefore little need for planning-led investigation or where the landscape is not conducive to survey. This approach can lead to a 'data bias', resulting in an only partial understanding of the characteristics of the buried archaeological assets that may be present. However, there are increasing examples across the country where areas previously thought to be devoid of archaeological activity are

[1] Department for Communities and Local Government, 2012, *National Planning Policy Framework.*

being revealed as landscapes used by our ancestors for a range of purposes. The traditional approach, particularly on linear projects that traverse areas of differing landscape characteristics, can result in missed opportunities to extend understanding of the character and extent of buried archaeological assets across the landscape as a whole.

1.3.2 Paragraph 169 of the NPPF highlights the need for up to date evidence to predict the likelihood that currently unidentified heritage assets, particularly sites of historic and archaeological interest, will be discovered in the future. This approach is reflected in the Scope and Methodology Report (SMR see Volume 5; Appendix CT-001-000/1); a risk-based approach to survey is adopted, taking consideration of a series of archaeological 'zones' or 'character areas', as opposed to point specific assets.

1.3.3 A 'zone' or 'character area' based approach to the cultural heritage enables the disparate information sources collected during the EIA process to be ordered and characterised, in a way which allows consideration to be given to all parts of the landscape. Such an approach has been advocated by EH. Phase One of HS2 traverses contrasting regions crossing wide tracts of land. Although it is unlikely that these zones will correspond with community forum areas (which form the basis of public consultation and the structure), they can be used to order the data into meaningful areas/zones, providing a context in which predictions can be made about the likely locations, nature and significance of archaeological assets.

1.3.4 It is also necessary to understand the potential impacts on specific assets, in particular where those assets are, or might be, designated (NPPF para 139). The approach here will be to concentrate on those assets where there is insufficient evidence to understand that impact.

# 2 Risk Based Predictive Methodology

## 2.1 The EIA Process

2.1.1 It is not proposed here to reiterate the cultural heritage EIA methodology as presented in the SMR, but rather to guide the use of that methodology in defining archaeological risk in relation to the selection of sites for field survey.

2.1.2 During the desk-based element of the EIA, archaeological character zones and the level of archaeological risk they hold will be defined.

2.1.3 The work undertaken as part of the cultural heritage EIA comprises the collection, synthesis and interpretation of available baseline data. The first phase of research focuses on a range of existing data sources, e.g. designated asset records, Historic Environment Records, historic maps and academic publications. Techniques such as LiDAR and hyperspectral surveys will be used to provide further information about the historic landscape. The zones will be refined a number of times during the EIA process to reflect increased understanding (e.g. following the completion of an element of survey). The descriptions of the zones will be proportionate to the nature of the archaeology and will focus on describing known archaeological character and potential for remains. The factors that may have affected survival and recovery will also be considered, for example agricultural practices and levels of recent development. The geology, topography, hydrology and historic character of the landscape will also be considered.

## 2.2 Examples of Prediction

2.2.1 During the preparation of the EIA for the M4 road scheme, trial trenching was not possible in the majority of locations due in particular to the sensitive habitats of the Sites of Special Scientific Interest. LiDAR was used to locate and map previously unknown Medieval farming enclosures and the route of old watercourses where, for example, there were likely to be survivals of Romano-British activity. This enabled the likelihood of impacts and their significance to be assessed by using comparative fieldwork data[2].

2.2.2 The M1 widening junctions 21-30 project also used LiDAR to good effect to reveal the hidden archaeological landscape and to guide assessment and subsequent field evaluation. The use of LiDAR in combination with available borehole data provided key insights into buried archaeological deposits in relation to the soil and geological deposits, thus allowing more effective prediction for the design of field work undertaken for the EIA as well as to guide the scheme development process[3].

## 2.3 Input from English Heritage and Local Planning Authority archaeologists

2.3.1 This assessment of archaeological risk in relation to, in particular, the issue of the unavailability of land for field evaluation has been discussed with consultees. EH and LPA archaeological officers have reviewed their respective counties and regional areas and have provided their interpretation of character zones based on their curatorial knowledge. This will be presented as a gazetteer describing the nature and elements of the zones and is supported by GIS mapping delineating the zone (Volume 5, Appendix 1 and Map Book series CH-03).

2.3.2 This information will feed into the research to aid in the assessment and consideration of perceived blank areas and/or those areas where further characterisation is considered necessary to assess the potential impact of the scheme. Proposals will be prepared for field evaluation (see Appendix A). As part of the process the known assets will be identified where field evaluation will inform an understanding of the potential for impacts. It is recognised that as part of the development of the zones, assets may extend outside of the area of, or be situated beyond, the boundary of land required for the construction and operation of the Proposed Scheme but will continue to have an influence on the definition of risk.

# 3 Field evaluation selection

3.1.1 Following on from the desk-based stage, field evaluation will be proposed, following standard industry practice, where appropriate and possible. The purpose of the field evaluation programme is primarily to:

- provide definition of the assets to aid the decision making process;
- clarify the presence/absence of heritage assets;
- establish the significance of heritage assets;

[2] Wessex Archaeology (2011), *New M4 Project, Baseline conditions Report,* Unpublished client report number 76880.02.
[3] University of Birmingham (2007), *M1 Junction 21-30 Widening Airborne Laser Scanning (Lidar) Analysis*, Unpublished client report.

- inform the understanding of the potential harm to the significance of heritage assets;
- contribute to the reduction of the risk of unexpected discoveries as far as is practicable within the compilation of the EIA; and
- inform the design and mitigation strategies.

## 3.2 Factors determining selection

3.2.1 A number of factors will guide the selection of the locations for field evaluation. These factors will focus on the level of previous work and the state of our understanding and will include:

- locations where there is a lack of archaeological knowledge due to, for example a lack of research, or developer led investigations;
- investigations in the surrounding locality where the presence of a specific monument and/or type of evidence is suggested – known patterns of discovery;
- the context of these investigations i.e. have the investigated locations themselves been biased by misconceptions regarding potential landscape models?;
- geology, soils, topography, hydrology indicators, noting for example, deep deposits, potential areas for palaeo-environmental and/or waterlogged survival, as well as, for example, hilltop defensive locations, routeways; and
- influence of past landuse, e.g. quarrying, urban expansion, agricultural regime – influence of heritage asset survival.

3.2.2 Tying the above together will be the use of professional judgement and experience, knowledge and experience employed to develop an understanding based on the assessment of the above points.

3.2.3 No field evaluation surveys will be required in support of the EIA if there is sufficient known information on the likely extent, value and vulnerability of buried remains from previous field surveys; and/or where desk-based sources (e.g. LiDAR, aerial photographs) provide enough evidence on the site type with an appropriate degree of confidence. No field evaluation surveys will be required where existing information currently allows a sufficient assessment of the impacts.

## 3.3 Site Selection Table

3.3.1 To capture the processes, the template for 'Site Selection' will be completed setting out a robust commentary on the site selection for surveys. An illustrative example is provided in Appendix A. This table will take each location within the Study Area and use the known information and predicted archaeology from the character zones to assess 'the need, appropriateness and feasibility' of field surveys. This will allow for a robust understanding of the decision making process during the EIA process as well as providing an audit trail.

3.3.2 Appendix B details the overall process, illustrating the stages presented in this technical note, from the collection of baseline data to the incorporation of the results of field evaluation survey into the EIA.

## 3.4 Categorisation of Risk

3.4.1 In order to take forward the categorisation of risk for those areas where selective field evaluation has been identified the following ranking has been developed. It is recognised that in the development of the model and the assignment of ranking, as defined in Table 1, the application of professional judgement is a key element in the definition of the levels of risk. However the definitions have been formulated to provide as far as possible a quantitative assessment of the risk for each zone identified.

Table 1: Categorisation of Risk

| Ranking | Risk rating | Criteria to define rank/risk rating |
|---|---|---|
| 1 | Very high | Area where there is no site specific data available to characterise archaeological assets, but data from other sources, for example boreholes and historic landscape analysis, indicates that significant remains may be present. |
| 2 | High | Area where archaeological character is poorly understood and where data collected indicates that the area is likely to contain archaeological remains of significance. |
| 3 | Medium | Area where archaeological character is partially understood and further detail would help clarify the nature of deposits to inform the assessment, where significant remains are suspected. |
| 4 | Low | Area where archaeological character is very well understood and sufficient data is available to characterise these to inform the assessment. |
| 5 | None | Area where archaeological remains are known to have been removed by past activity and the chances of encountering assets are reduced to essentially nil. |

3.4.2 Areas that meet a risk rating of 1 and 2 will be taken forward for field work as a priority to inform the EIA.

3.4.3 Where access for field evaluation is not possible, the assessment will set out the reasonable worst case scenario, based on professional judgement and the information available.

# 4 Evaluation Techniques

4.1.1 For each location, the evaluation technique will be specified. In some instances a suite of techniques may be envisaged and where possible these should be stated. Although not an exhaustive list, the following comprises the likely suite of evaluation techniques for which access may be requested:

### Non-intrusive

- walkover (site reconnaissance);
- field walking/surface artefact collection;
- geophysical survey;
- metal detecting (for distribution only); and
- other (specify).

## Intrusive

- metal detecting;
- borehole/augering;
- test-pitting;
- trial trenching; and
- other (specify).

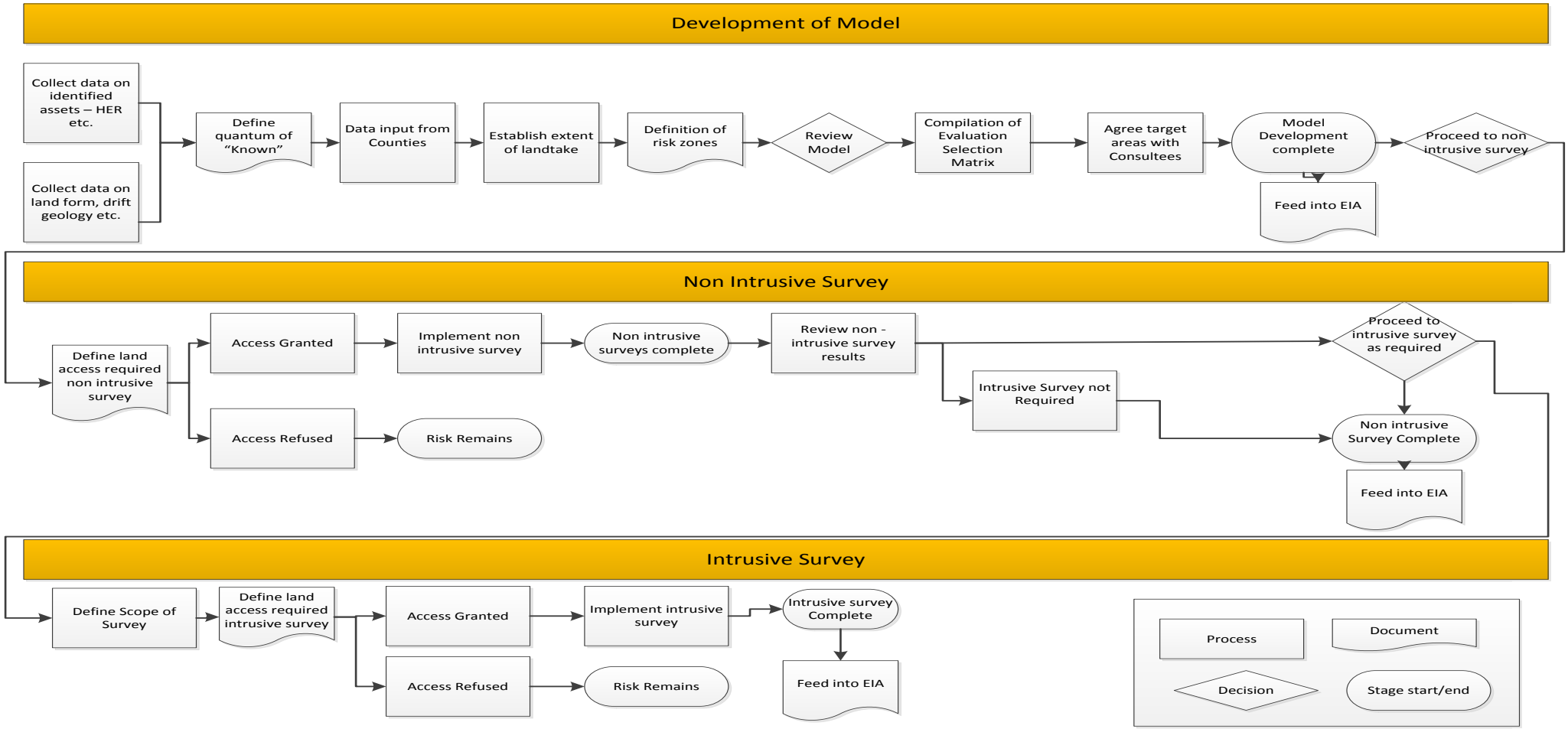
# Appendix A: Tables

Table A 1 Example site selection table (Provided for illustration only)

| Item no. | Community forum area | Archaeological character zone | Sub-zone | Site name / location | Chainage | Indicators of potential (e.g. find spots, cropmarks, earthworks, proximity of known sites nearby, topography/geology) | Can a robust commentary be provided on the extent/value of archaeological assets based on existing sources? | Risk rating | What info is needed to provide a robust commentary? What are the questions requiring answers? | What field survey techniques are available to answer outstanding questions? | Access to land? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Offchurch & Cubbington | Dunsmore and Avon Valley | A209/210 | Route of the former Bytham river | X to Y | Projected route of the Pre-Anglian Bytham river (A2026). Palaeolithic finds of National, possibly international, importance have been recovered from deposits within this former river c. 1.8km to the north east of the Study Area. Further such finds may survive in the section that crosses the site. Ridge and furrow systems located immediately to the north west and south east of the site. Baseline study suggests a **National** significance for remains of **High** value | Given the proximity of the site to the known route of an ancient river known to contain Palaeolithic material it is important to establish whether similar deposits are located within the temporary and permanent land take. The depth of the palaeo-channel below current ground level also has also to be established. | 2:High | Does the route of the Bytham actually pass through the Site?<br>At what depths below current ground level do these deposits survive?<br>Are the depths at which they survive likely to be impacted by the proposed scheme? | The following staged works proposed. **Borehole/auger survey** To test whether deposits associated with the Bytham palaeo-channel survive within the site.<br>**Trial Trenching**<br>Targeted trial trenches over areas of potential identified from borehole results in order to further investigate palaeo-channel deposits and recover datable finds. | TBC |
| 2 | Greatworth to Lower Boddington | Edgcote | (TBC) | Likely Roman Villa | X to Y | Pasture, south facing slope with plateau; extensive curvi-linear & linear cropmarks nearby on arable land | No | 1: Very High | Do buried archaeological remains survive on site? Are they of schedulable quality? Most likely site type - enclosed (& unenclosed) late | Geophysics should reveal cut/filled & burnt features of settlement remains. If no evidence from | |

| Item no. | Community forum area | Archaeological character zone | Sub-zone | Site name / location | Chainage | Indicators of potential (e.g. find spots, cropmarks, earthworks, proximity of known sites nearby, topography/geology) | Can a robust commentary be provided on the extent/value of archaeological assets based on existing sources? | Risk rating | What info is needed to provide a robust commentary? What are the questions requiring answers? | What field survey techniques are available to answer outstanding questions? | Access to land? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | but none within footprint; no find spots or earthworks; nothing on LiDAR but cropmarks nearby also don't show up on LiDAR; scheduled villa site overlying prehistoric settlement located 3km down the valley (similar topographical site characteristics) | | | prehistoric / early Roman settlement; how can we find these? | geophysics no further field surveys | |
| 3 | Dunsmore, Wendover & Halton | Misbourne Valley | (TBC) | Grim's Ditch | X to Y | Scheduled linear earthwork of probable Iron Age date, running for 25km+ in sections; no known associated remains other than in-filled ditch and bank; | Yes | 4: Low | Excavated sections elsewhere provide sufficient information to extrapolate likely extent of survival. | n/a | |

Table A 2: Risk process



# HS2 London-West Midlands

# Cultural heritage

# Technical note -Fieldwalking

## A report to HS2 Ltd by Arup/URS

# Contents

# 1 Introduction

1.1.1 This document describes the minimum requirements and standards for fieldwalking surveys to inform the cultural heritage assessment of HS2 Phase One or the 'Proposed Scheme'.

# 2 Scope of works

## 2.1 Overview

2.1.1 The objectives are to gather information on the character, location and extent of any surface indications, in the form of artefact scatters or concentrations, of potential sub-surface archaeological features and material that only exists within the plough soil, such as flint scatters. The specific locations for the surveys to support the formal Environmental Statement (ES) have been defined in accordance with the Cultural heritage Risk based approach to archaeological assessment Technical Note (see Annex C of the SMR addendum). The content of this technical note is also to be used for survey work that may be undertaken following the deposition of the ES and in advance of construction.

## 2.2 Pre-fieldwork activities

2.2.1 Prior to the implementation of the fieldwork the following activities shall be undertaken and documented:

- a Written Scheme of Investigation (WSI) shall be compiled detailing the methodologies to be used for all stages of the works including a site plan/s and the site recording pro forma (see section 9.1.3) identifying the limits of each fieldwalking event, for issue to Local Planning Authority (LPA) Archaeologists. The WSI shall be issued in accordance with standard document control processes;
- a site code for each fieldwalking event shall be obtained in liaison with the LPA Archaeologist (county or unitary authority) or other appropriate representative. The museum archive accession code shall also be obtained, as appropriate to each county for each event;
- liaison with other disciplines, in particular ecology, to identify and implement any restrictions on the works resulting from interdisciplinary considerations, such as the presence of protected species;
- appropriate arrangements shall be made to ensure the protection and safe storage of all artefacts recovered during the works, including requirements for conservation of artefacts. This shall encompass fieldwork, post excavation activities and the storage of material in advance of archive deposition; and
- site visits to determine if the ground conditions (e.g. crop cover, weathering, ploughing regime) are suitable for the fieldwalking survey and to identify any factors that may influence the survey.

# 3 Reference standards

3.1.1 All stages of the works shall be managed and implemented in accordance with industry best practise and guidance in relation to the management of archaeological projects. This shall include, but not be limited to:

- Institute for Archaeologists, 2008, Standard and Guidance for Archaeological Field Evaluation; Institute for Archaeologists, Revised 2008, Standard and Guidance for the collection, documentation, conservation and research of archaeological materials;
- RESCUE/United Kingdom Institute for Conservation, Archaeology Section and Museum of London, 1998, First Aid for Finds. (3rd edition); and
- English Heritage, 2006, Management of Research Projects in the Historic Environment (MORPHE): Project Manager's Guide.

# 4 Project management documents

4.1.1 A programme risk log shall be prepared and shall consist of a tabulated schedule by event, in spread sheet format detailing the proposed start and completion dates for the fieldwork and off-site activities including the milestone for the delivery of the draft report. An example format is provided in Appendix A. It is recognised that access arrangements shall be a key factor in determining the availability of survey areas and the development and implementation of the fieldwork programme.

# 5 Access

5.1.1 All access arrangements to undertake the surveys shall be made by HS2 Ltd in liaison with the teams carrying out the surveys. It is the responsibility of the survey teams to ensure that they comply with HS2 Ltd access procedures and any specific requirements imposed by land owners and/or their tenants.

# 6 Health and safety

6.1.1 Health and safety shall take priority over archaeological matters. All operatives undertaking fieldwork must comply with all relevant health and safety legislation and HS2 Ltd project procedures. Prior to the commencement of any fieldwork activities it shall be necessary to ensure that all health and safety documentation required by HS2 Ltd has been completed and signed off.

# 7 Personnel

7.1.1 The teams undertaking the survey works shall have the relevant experience and competency to undertake the works required.

# 8 Monitoring

8.1.1 The fieldwork and reporting outputs shall be monitored and reviewed to ensure compliance with this document and industry standards.

**Setting out and location of grid.**

8.1.2 Data shall be collected along regularly spaced transects within a regularly spaced survey grid. All recorded survey data shall be collected with reference to the survey grid. Where the survey area approaches boundaries or obstructions, partial grids shall be set out and surveyed using sightlines. The survey transects shall generally be aligned with the long axis of each survey area.

8.1.3 The survey grid shall be established using Real Time Kinematic (RTK) differential GPS equipment. However, on rare occasions where this is not practicable (i.e. no phone cell network; trees or buildings present, not lack of equipment), other methods such as Total Station, optical square, ranging rods and tape measures may be used.

8.1.4 The survey grid shall be marked out by appropriate means and grid nodes shall be set out with a positional accuracy of at least 100mm (0.1m). A sample of the grid markers shall be re-checked at the start of each working day to ensure consistencies in surveying and to ensure that grid markers have not been tampered with. In this event, HS2 Ltd shall be provided with the details of the method/s used and the areas where the survey technique was deployed.

8.1.5 GPS measurements shall be taken to allow the accurate relocation of the survey grid by a third party and for the production of maps and diagrams in the report. On request, written evidence of the calibration of all equipment to be used in the surveys in accordance with the manufacturer's specification is to be provided. Calibration or reference measurements shall be made using GPS to clearly defined features (such as buildings) which appear on the mapping: poorly defined field boundaries or corners shall not be used. In the event that no clearly defined features are within reasonable distance of the grid, sturdy marker stakes shall be left in situ at boundaries and the coordinates recorded by GPS for calibration when re-establishing the grid.

8.1.6 On completion of the survey all pegs/canes and any other temporary markers shall be removed from the survey area, with the exception of any calibration markers (see paragraph 9.1.4).

8.1.7 A survey record of the grid location in the form of a Grid Relocation Plot / Figure, at a suitable scale showing the survey area and grid subdivisions, key GPS co-ordinates and calibration points; all sufficient to enable the accurate location of the grid on mapping and re-establishment in the field shall be provided. All recorded GPS measurements shall be OSTN02/OSGB36 coordinate format.

# 9 Fieldwork

9.1.1 In undertaking the fieldwork, as a minimum the following shall be implemented:

- fieldwalking shall take place over each suitable field using transects with a survey grid established at regular intervals. The spacing of the survey grid intervals for the collection of material shall be determined on a site by site basis depending on the specific survey objectives and circumstances of the anticipated assets or specific objectives for each fieldwork event. Finds shall be bagged at the same interval along each transect to form the grid, usually 20m;

- the bags used for the collection of artefacts from each search area shall be marked with the following as a minimum:
  - site code;
  - field number; and
  - twelve digit National Grid Reference (NGR) number with the NGR being the southern end of each survey grid walked; and
  - interval number.

9.1.2 All artefacts, including bone, shall be recovered, except those of clearly modern origin. In these circumstances the location of such artefacts/spreads of material shall be clearly identified in relation to the survey grid. For bulk ceramic building material and industrial waste sufficient sample should be collected to characterise the material present.

9.1.3 A site recording pro forma shall be completed on a daily basis during the course of the fieldwork. This as a minimum is to identify the following:

- date of survey;
- NGR;
- weather conditions;
- land use/field conditions;
- ground visibility;
- any other factors influencing the survey results; and
- personnel deployed.

9.1.4 On completion of the survey all materials, grid pegs and other equipment used in the fieldwork shall be removed and the survey and associated working areas shall be left in a clean and tidy condition.

# 10 Post fieldwork

10.1.1 On completion of fieldwork, or earlier depending on the programme, all artefacts recovered shall be washed, marked and bagged, assessed, conserved (where appropriate) and packaged in accordance with professional best practice and standards.

10.1.2 An ordered, indexed, and internally consistent site archive shall be compiled in accordance with the requirements of Archaeological Archives Forum, 2007[1], and any particular requirements of the Local Authority within which the works are being undertaken.

10.1.3 All digital data shall be produced in a format that is compliant with HS2 Ltd data standards and is capable of being deposited with the Archaeology Data Service (ADS).

[1] Archaeological Archives: A Guide to Best Practice in Creation, Compilation, Transfer and Curation.

Further details of HS2 Ltd proposals for the deposition of a digital archive with ADS are provided in section 12.

10.1.4 All artefacts recovered during the fieldwork shall be examined by appropriately qualified specialists utilising national and local type series for pottery.

10.1.5 Where appropriate, conservation of artefacts recovered may be required that shall necessitate the deployment of staff with the necessary experience to undertake the appropriate works on the classes and types of material recovered.

# 11 Reporting

## 11.1 General

11.1.1 A report shall be compiled detailing the findings of the fieldwork for each event. This shall contain a textual narrative supported by drawings illustrating the results of the fieldwork.

11.1.2 The report shall be produced in the HS2 Ltd standard report document template format. All documents shall be issued in accordance with the appropriate document control processes.

11.1.3 The unique land parcel identification number that has been allocated by the HS2 Ltd land access team to enable ready identification of the survey area within HS2 Ltd systems shall be identified.

11.1.4 An online access to the index of archaeological investigations (OASIS) form shall be completed and this shall be included with the final report for each event. Electronic copies of the form shall not be uploaded until instructed and all paper copies shall contain all metadata necessary to complete online data requirements.

11.1.5 Draft copies of the site and artefact distribution plans shall be provided in PDF format for review and comment. Each event (discrete area of survey) shall be issued as a separate report.

11.1.6 The final issue of reports shall consist of:

- One CD containing:
  - a PDF copy of the report;
  - the text of the report in the format in which they were produced;
  - figures in the format in which they were produced;
  - all artefact catalogues and other supporting information in the format in which they were produced; and
- One CD containing CAD and GIS data in an Esri format

11.1.7 All electronic data received shall be transferred for long term storage and retrieval within the projects data management system.

11.1.8 The HS2 Ltd data standards shall be adhered to for all reports and data sets that are issued.

11.1.9 The format of the plans shall be compliant with HS2 Ltd data standards and in particular the production of plans in GIS format. Plans and figures may be produced in CAD but shall also be required in GIS format.

11.1.10 Copies of the final report shall be issued to HS2 Ltd for submission to the relevant LPA Archaeologists and English Heritage and shall be issued in accordance with HS2 Ltd data standards.

## 11.2 Report content

11.2.1 The headings and contents of each report shall conform to the following structure, and as a minimum contain:

- a summary of the results written for a non-specialist audience;
- contents page;
- introduction;
  - event location;
  - site description; and
  - survey objectives - the rationale and circumstances of the work including previous works and other planned or completed HS2 works.
- methodology;
  - survey methods used and any limitations;
  - date(s) of fieldwork;
  - grid location and transect intervals;
  - method(s) of data capture including any biases or other factors that may have influenced the survey results;
  - method(s) of data processing including any biases or other factors that may have influenced the survey results; and
  - methods of data presentation including any biases or other factors that may have influenced the survey results.
- results;
  - description of results;
  - interpretation of results; and
  - data tables providing a quantification of the material recovered.
- conclusions; and
  - to include justified recommendations for further work.
- plans;

- a location plan showing the position of the survey area within the landscape by reference to existing features such as roads and other tangible features. The plan shall be produced at a scale of 1:10,000 or alternative scales, for example 1:2500, agreed with HS2 Ltd in advance of the production of the plan; and
- plans showing the distribution of transects walked and the densities of and spatial distribution of materials recovered by type. Plans shall be produced at a scale of 1:5,000 or alternative scales, for example 1:2500, agreed with HS2 Ltd in advance of the production of the plans.

11.2.2 All reports shall contain the following sections:

- report text;
- list of figures;
- report figures; and
- appendix detailing technical information.

11.2.3 The report text shall:

- describe the site and situation of the survey area and the prevailing local topography, land use, soils and geology;
- provide a brief description of any known archaeological remains in the vicinity including the archaeological character zones formulated as part of the compilation of the Risk Model, and their relevance to the survey results;
- state the aims and objectives of the survey including reference to the Archaeological Character Zones;
- describe any general factors or complications which must be considered when viewing the data. These shall include any local factors which may hinder the collection or interpretation of the results;
- assess the results in accordance with the aims of the survey, including period represented incorporating absence of data representation; and

11.2.4 A database of all artefacts recovered shall be compiled for deposition.

11.2.5 The report text shall be supported by and cross referenced to site plans and drawings. The contents of the figures shall be dependent on the nature of the material recovered and may require the production of multiple figures depending on the quantity and diversity of material that is recovered during the fieldwork. Site plans shall be produced at a clearly legible scale to enable the full detail of the fieldwork results to be clearly discernible. This may require the use of multiple sets of plans to illustrate the data.

# 12 Archive

12.1.1 Normal industry practice shall be followed for the preparation of all archives generated during the course of the survey work. HS2 Ltd requires compliance with

industry archive standards for digital data as well as those of HS2 Ltd (which are more stringent).

# Appendix A: Example of Programme/Progress Report

| Event Name | Fieldwork | | | | Reporting | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Start | | Finish | | Start | | Issue Draft report | | Final Report | | Summary of findings |
| | Plan | Actual | Plan | Actual | Plan | Actual | Plan | Actual | Plan | Actual | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

# HS2 London-West Midlands

# Topic – Cultural heritage

# Technical note – Geophysical survey

## A report to HS2 Ltd by Arup/URS

# Contents

# 1 Introduction

1.1.1 This document describes the minimum requirements and standards for geophysical surveys to be undertaken as part of the compilation of the Environmental Statement (ES) for Phase One of HS2.

# 2 Scope of works

## 2.1 Overview

2.1.1 The objectives are to gather information on the character, location and extent of any archaeological deposits, and to gain an understanding of the subsurface environment as a whole, as far as the data shall allow. The specific locations for the survey have been defined in accordance with the Cultural heritage Risk based approach to archaeological assessment Technical Note (see annex C of the SMR addendum). This technical note is also to be used during survey work that may be undertaken following the deposition of the ES and in advance of construction.

## 2.2 Pre-fieldwork activities

2.2.1 Prior to the implementation of the fieldwork the following activities shall have been undertaken and documented:

- a Written Scheme of Investigation (WSI) shall be compiled detailing the methodologies to be used for all stages of the works including a site plan/s and shall be agreed for issue to Local Planning Authority (LPA) (County or Unitary Authority) Archaeologists. The WSI shall be issued in accordance with standard document control processes;
- prior to the issue of the draft report in liaison with the LPA (County or Unitary Authority) Archaeologist, or other appropriate representative, the requirements for obtaining a site code for each survey event shall be obtained. A museum archive accession code, as appropriate to each County shall be obtained for each event;
- liaison with other disciplines, in particular ecology, shall be undertaken to identify and implement any specific requirements resulting from the presence of restrictions on the manner of working for example protected species; and
- the location of the work shall be visited to determine if the ground conditions (e.g. crop cover, weathering, ploughing regime) are suitable for geophysical survey and if there are any factors that shall influence the survey.

# 3 Reference standards

3.1.1 All stages of the works shall be managed and implemented in accordance with industry practice and guidance in relation to the management of archaeological projects. This shall include, but not be limited to:

- English Heritage, 2008, Geophysical Survey in Archaeological Field Evaluation;

- Institute for Archaeologists, 2002, Paper 6, The use of geophysical techniques in archaeological evaluations;
- Institute for Archaeologists, 2011, Standard and Guidance for archaeological geophysical survey;
- English Heritage, 2006, Management of Research Projects in the Historic Environment (MoRPHE): Project Manager's Guide; and
- All relevant codes, standards, guidelines, regulations and legislation in force at the time of the works.

# 4 Project management documents

4.1.1 A programme risk log shall be completed and shall consist of a tabulated schedule by site, in spreadsheet format detailing the proposed start and completion dates for the fieldwork and off-site activities including the milestone for the delivery of the draft report. An example format is provided in Appendix A. It is recognised that access arrangements shall be a key factor in determining the availability of survey areas and therefore the development and implementation of the fieldwork programme.

# 5 Access

5.1.1 All access arrangements to undertake the surveys shall be made by HS2 Ltd in liaison with the teams carrying out the surveys. It is the responsibility of the survey teams to ensure that they comply with all of HS2 Ltd access procedures and any specific requirements imposed by land owner and/or their tenants.

# 6 Health and safety

6.1.1 Health and safety shall take priority over archaeological matters. All operatives undertaking fieldwork must comply with all relevant health and safety legislation and HS2 Ltd project procedures. All operatives undertaking the fieldwork shall be appropriately qualified, competent and adequately insured to undertake such projects. Prior to the commencement of any fieldwork activities all health and safety documentation required by HS2 Ltd shall be completed and signed off.

# 7 Personnel

7.1.1 The teams undertaking the survey works shall have the relevant experience and competency to undertake the works required.

# 8 Monitoring

8.1.1 The fieldwork and reporting outputs shall be monitored and reviewed by the routewide geophysics specialist to ensure compliance with this document and industry standards and practice.

## Setting out and location of grid[1].

8.1.2 For all techniques data shall be collected along regularly spaced traverses within a site survey grid. All recorded survey data shall be collected with reference to the grid or survey baselines. For gradiometer and resistance survey this grid shall normally consist of individual 20m x 20m or 30m x 30m squares. Where the survey area approaches boundaries or obstructions partial grids shall be set out and surveyed using sightlines. For ground penetrating radar (GPR) or other techniques the grid size may vary with the size of the survey area. In some instances, magnetic, resistance and GPR data may be collected with a GPS feed, negating the requirement for a rigid survey grid to be laid out.

8.1.3 As standard the survey grid shall be established using Real Time Kinematic (RTK) differential GPS equipment. However, on rare occasions where this is not practicable (i.e. no mobile telephone; trees or buildings present, not lack of equipment), other methods such as Total Station, optical square, ranging rods and tape measures may be used. In this event, details are to be provided of the method/s used and the areas where the survey technique was deployed.

8.1.4 The survey grid shall be marked out by appropriate means and grid nodes shall be set out with a positional accuracy of at least 100mm (0.1m) as required by English Heritage (EH) guidelines[2]. A sample of the grid markers should be re-checked at the start of each working day to ensure consistencies in surveying and to ensure that grid markers have not been tampered with.

8.1.5 GPS measurements shall be taken to allow the accurate relocation of the survey grid by a third party and for the production of maps and diagrams in the report. On request, written evidence of the calibration of all equipment to be used in the surveys in accordance with the manufactures specification is to be provided. Calibration or reference measurements shall be made using GPS to clearly defined features (such as buildings) that are fixed reference point which appear on the mapping: poorly defined field boundaries or corners shall not be used. In the event that no clearly defined, features are within reasonable distance of the grid, sturdy marker stakes shall be left in situ at boundaries and the co-ordinates recorded by GPS for calibration when re-establishing the grid.

8.1.6 On completion of the survey (i.e. when all data have been collected, downloaded to computer, visually examined, and backed up to an external device) all pegs/canes and any other temporary markers shall be removed from the survey area, with the exception of any calibration markers (see 8.1.4 and 8.1.5).

8.1.7 A record of the survey grid location should be provided. This should be in the form of a Grid Relocation Plot / Figure, at a suitable scale showing the survey area and grid subdivisions, key GPS co-ordinates and calibration points; all sufficient to enable the accurate location of the grid on mapping and re-establishment in the field. All recorded GPS measurements shall be OSTN02 co-ordinate format.

[1] For GPS (Global Positioning System) also read GNSS (Global Navigation Satellite System).
[2] English Heritage (2008), *Geophysical Survey in Archaeological Field Evaluation.*

# 9 Data Collection

## 9.1 All techniques

9.1.1 During fieldwork a record of surface and weather conditions shall be maintained that may have a bearing upon the quality and the subsequent interpretation of the data. Where appropriate, and in the event that an area is deemed unsuitable for survey, a photographic record shall be maintained.

9.1.2 While in the field, the data shall be regularly transferred from the instruments onto a laptop computer using the appropriate software and the results viewed to ensure data integrity. All data shall be copied to an external storage medium as a back-up before deletion from the instrument's memory.

## 9.2 Magnetometer Survey

9.2.1 Instruments to be used for data collection shall be Bartington Grad 601-2. Other magnetometer configuration shall only be used with the prior written agreement of HS2 Ltd.

9.2.2 The standard sample interval (along traverse) shall be 0.25m; the standard traverse interval shall be 1.00m. The total number of data points collected shall thus be 1600 readings per 20m x 20m grid square or 3600 per 30m x 30m square. All measurements used and detailed in reports shall be in SI Units and reported in accordance with HS2 Ltd requirements.

9.2.3 Data shall not be collected in areas where the operative is unable to maintain an even pace whilst holding the instrument steady, i.e. areas of dense and/or tall vegetation, crop, uneven, deeply ploughed or heavily rutted fields. HS2 Ltd shall be informed as soon as possible should such conditions be encountered.

9.2.4 On a weekly basis, a photographic record of all areas deemed unsuitable for survey shall be submitted.

## 9.3 Resistance Survey

9.3.1 Instruments to be used for data collection shall be Geoscan RM15/MPX15 or RM85 meters. Other suitable resistance meters shall only be used with the prior written agreement of HS2 Ltd.

9.3.2 The standard array shall be Twin Probe with a probe spacing of 0.5m. The standard sample interval (along the traverse) shall be 1.00m with a standard traverse interval of 1.00m. The total number of data points collected shall thus be 400 readings per 20m x 20m grid square or 900 per 30m x 30m. Alternatively a Geoscan cart system can be employed. Other systems are to be agreed in writing prior to deployment.

## 9.4 GPR Survey

9.4.1 Instruments to be used for data collection shall be agreed with HS2 Ltd prior to survey. Antennas shall typically be in the 200MHz or 800 MHz range with the centre chosen in response to the specific penetration and resolution requirements of the suspected deposits. In some cases it may be necessary to use systems operating

beyond these limits but this would be made clear at the specific site and shall not be undertaken without the prior written agreement of HS2 Ltd.

9.4.2 Standard sample intervals (along the traverse) shall be 0.05m and the standard traverse interval shall be 0.50m.

9.4.3 Radar equipment shall only be operated under an OfCom "Ground Penetrating Radar" licence – refer to the following information sources:

- http://licensing.ofcom.org.uk/binaries/spectrum/low-short-devices/ground-probing-radar/ofw350.pdf, and
- http://www.eurogpr.org/joomla/images/documents/eg_202730v010101p0909.doc

9.4.4 Data shall not be collected in areas unsuitable for survey due to ground conditions, for instance where ground cover does not allow for good 'coupling' of the antenna; where rebar mesh or similar produces near total reflection of the signal; or where soil conditions (either type or water content) result in extreme attenuation of the signal, significantly reducing penetration.

## 9.5 Other techniques

9.5.1 Should other techniques be required, a specification shall be provided for approval prior to the implementation of any such works. This may include metal detector survey where the deployment of this evaluation technique has been selected as an appropriate fieldwork technique.

# 10 Data Processing

10.1.1 Data processing shall be performed using appropriate software. The surveyor shall state whether a commercially available software package (to be identified) or the surveyor's own is used for each technique.

10.1.2 Processing shall be the minimum (as defined by Paragraph 4.8 (EH 2008)) i.e. edge matching or step-correction is permissible, but not filtering). There shall be a statement relating to any processing that has been applied. All stages of the processing shall be fully documented in the report. Raw or minimally processed data plots shall be provided as Reference Plots (see section 11.4).

10.1.3 Data processes shall be independently analysed and where inappropriate steps have been applied, these shall be communicated to the relevant surveyor who shall be responsible for ensuring implementation of the appropriate actions to rectify any such steps and that data issued to HS2 Ltd is amended accordingly.

# 11 Reporting

## 11.1 General

11.1.1 A report shall be compiled detailing the findings of the fieldwork for each event. This shall contain a textual narrative supported by a drawing to illustrating the results of the fieldwork. The document shall be issued in accordance with the appropriate document control processes.

11.1.2 Each report should identify the unique land parcel identification number that has been allocated by the HS2 Ltd land access team to enable ready identification of the survey area within HS2 Ltd systems.

11.1.3 An Online Access to the index of archaeological investigations (OASIS) form shall be completed for each event. Electronic copies of the form are not to be uploaded until instructed and all paper copies shall contain all metadata necessary to complete on line data requirements.

11.1.4 A draft copy of the text, greyscale images and interpretations shall be provided to HS2 Ltd in PDF format for review and comment. Each event (discrete area of survey) shall be issued as a separate report. All reports and data sets issued shall be in accordance with HS2 Ltd data standards.

11.1.5 The final issue of reports shall consist of:

- One CD containing:
  - a PDF copy of the report;
  - the text of the report in Microsoft Word Format;
  - figures in the format in which they were produced;
  - all processed raw data as separate files as Geoplot raw grid data (plus minimally processed in ASCII[3]) plus Geoplot mesh and comp files; and
- One CD containing CAD and GIS data in an Esri format. Metadata comprising the supply of a data sheet on format of grids, meshes and composites or their equivalent shall be provided.

11.1.6 All electronic data received shall be transferred for long term storage and retrieval within the projects data management system.

11.1.7 The HS2 Ltd data standards shall be adhered to for all reports and data sets that are issued.

11.1.8 The format of the plans shall be compliant with HS2 Ltd data standards and in particular the production of plans in GIS format. Plans and figures may be produced in CAD but are also required in GIS format.

11.1.9 Copies of the final report are to be issued to HS2 Ltd for submission to the relevant LPA Archaeologists and EH and shall be issued in accordance with HS2 Ltd data standards.

## 11.2 Report content

11.2.1 The headings and contents of each report are to confirm to the following structure:

- A summary of the results written for a non-specialist audience;
- Contents page;
- Introduction;

[3] American standard code for information interchange for transfer of text.

- event location;
- site description; and
- survey objectives - the rationale and circumstances of the work including previous works and other planned or completed HS2 works.

- Methods:
  - survey methods used;
  - date(s) of fieldwork;
  - grid location;
  - instruments used;
  - sampling intervals;
  - equipment configurations;
  - method(s) of data capture;
  - method(s) of data processing; and
  - methods of data presentation.
- Results
  - description of results; and
  - interpretation of results.
- Conclusions;
- Assessment of achievement (or not) of survey objectives;
- Results summarised;
- Plans/plots:
  - survey grid location (1:2,500 minimum)[4];
  - plot(s) of raw data (1:1,000 minimum);
  - minimally enhanced X-Y traces of magnetic data, where appropriate;
  - plot(s) of enhanced data (1:1,000 minimum); and
  - grey tone (or dot density) interpretation diagram (1:1,000 minimum).

11.2.2 The report text shall:

- describe the site and situation of a survey area and the prevailing local topography, land use, soils and geology;

[4] 1:2500 is preferred scale; 1:1250 also acceptable as is 1:5000 but not 1:10,000.

- provide a brief description of any known archaeological remains in the vicinity, including the archaeological character zones formulated as part of the compilation of the Risk Model, and their relevance to the survey results;
- state the aims and objectives of the survey;
- list and explain the display formats adopted and the processing applied;
- describe any general factors or complications which must be considered when viewing the data. These shall include any local factors which may hinder the collection or interpretation of the results; and
- assess the results in accordance with the aims of the survey. In the majority of cases, the anomalies shall be interpreted from the perspective of their archaeological potential.

11.2.3 All anomalies identified shall be assessed and classified according to the list of interpretation categories in section 12.1.2.

## 11.3 Figures

11.3.1 Maps and diagrams may be produced in CAD but shall be submitted in GIS, in accordance with HS2 Ltd data standards and guidance and shall accurately show the various survey blocks against an Ordnance Survey map background.

11.3.2 Report figures may be in A4 or A3 portrait or landscape layout.

11.3.3 All figures shall include a north point, scale bar, stated scale and title panel showing the project title, drawing title, drawing or figure number and initials of CAD draughtsperson.

11.3.4 All figures and CAD drawings shall conform to the CAD layering protocol described in this section, and shown in Appendix B.

11.3.5 An event location diagram at a scale of 1:50,000 or 1:25,000 and a plan showing the site location(s) at a suitable scale shall be provided. Areas of survey as referred to in the report text shall be labelled on the site location plan and on all figures. Survey area numbering shall be agreed before commencement of fieldwork.

11.3.6 Figures including .tif or .jpg images of processed data greyscale (with highest values in black) plots accurately positioned on the mapping shall be provided at a minimum scale of 1:2,500 or 1:1,000 and shall include a scale bar showing the plotting range. GPR data shall be displayed as radargrams and time-slices if appropriate. A representative selection of the latter shall be provided as a minimum.

11.3.7 Colour interpretation figures shall be provided to the same scale as the greyscale figures. The survey area(s) border(s) shall be accurately placed on the mapping, and all anomalies and responses identified and classified in the report text shall be plotted to scale and in the correct locations within the survey area(s). Interpretation classification shall be in accordance with the categories listed below, with each category assigned a specific layer, colour, line type and hatch type as listed below. Each interpretation figure shall include a key to all interpretation categories used in that figure. Where necessary for clarity, anomalies shall be referenced to the report text by means of numbers.

11.3.8 A separate layer shall be used for each interpretation category of anomaly shown on the interpretation diagrams. The layering protocol, colours, hatch type and linetypes shall conform to an appropriate standard.

11.3.9 All layer names shall conform to the following protocol:

- HS2_MAG_(name), HS2_RES_(name), HS2_GPR_(name) for magnetometer, resistance and GPR surveys respectively. Examples are:
  - Archaeology category - HS2_MAG_Archaeology: hatch solid, colour 190.
  - Ridge and furrow category -HS2_MAG_R_F: polyline type ACAD_ISO10W100, lineweight 0.25, scale 0.2, colour 35

## 11.4 Reference plots

11.4.1 Reference plots shall be used to verify the interpretation figures.

11.4.2 Reference plots may be produced in layouts up to A0, and shall be required on CD in PDF format only: they shall not be required to be bound into the paper copy report.

11.4.3 Reference plots of raw or minimally processed data comprising XY Trace plots and greyscale images, both plotted at ranges to suit the full range of the magnetic data shall be required. For resistance data a range typically -1 to 1 standard deviation shall be used for the greyscale (individual data grids must be edge matched where possible – allowing for effects of rain, for example). When using standard deviation for the plotting sale then actual values should be recorded (not simply '+/-1 Standard Deviation). For both magnetic and resistance data the plots shall be at a scale consistent with the interpretation plots.

11.4.4 Reference plots for GPR surveys shall comprise a full set of minimally processed (i.e. limited to signal correction, removal of instrument noise and gain) radargrams. These may be as image files on the reference CD provided that there is an accompanying diagram showing their relative positions and direction. The radargrams shall have clearly labelled lateral and vertical axes. If the vertical axis is in depth the transmission velocity for the conversion must be apparent. At least a representative selection of any processed radargrams that have been used for interpretation or time-slice production shall be included. If time-slices have been used, a full set of the resultant images shall be included in the archive.

11.4.5 Reference plots shall include a north point, scale bar, stated scale and title panel showing the project title, drawing title, drawing or figure number and initials of CAD draughtsperson. XY trace plots shall include a plotting range bar.

# 12 Interpretation categories

12.1.1 All identified anomalies and responses shall be assigned to one of the interpretation categories (see Section 12.1.2). Numbers (1, 2 and 3 etc.) shall be cross referenced with the figures in the text of the report and shall be assigned to specific anomalies of interest in the first three categories and subjectively to anomalies in other categories.

12.1.2 In certain circumstances (usually when there is corroborative evidence from desk based or excavation data) very specific interpretations can be assigned to magnetic

anomalies (e.g. Roman Road, Wall) and where appropriate, such interpretations shall be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

- Archaeology - definitive/probable;
- Archaeology – possible archaeology;
- Industrial/Burnt-Fired;
- Old Field Boundary;
- Agricultural(ploughing / R&F);
- Natural – pedological/geological/topographical;
- Uncertain Origin; and
- Ferrous/Magnetic Disturbance.

12.1.3 The category 'uncertain origin' encompasses those instances where it is not possible to differentiate between archaeology and natural and agricultural anomalies.

12.1.4 Where appropriate some anomalies shall be further classified according to their form (positive or negative) and relative strength and coherence (e.g trend: weak and poorly defined).

# 13 Archive

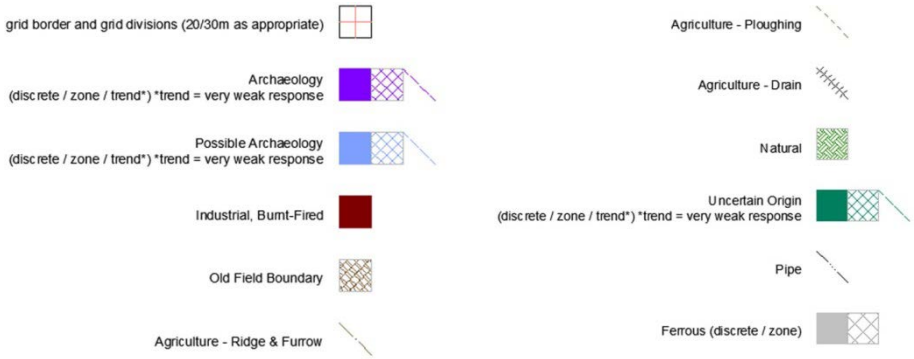
13.1.1 Normal industry practice shall be followed for the preparation of all archives generated during the course of the survey work .HS2 Ltd requires compliance with industry archive standards for digital data as well as those of HS2 Ltd (which are more stringent).

# Appendix A: Example of Programme/ Progress Report

| Event Name | Fieldwork | | | | Reporting | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Start | | Finish | | Start | | Issue Draft report | | Final Report | | Summary of Findings |
| | Plan | Actual | Plan | Actual | Plan | Actual | Plan | Actual | Plan | Actual | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

# Appendix B: Data Structures

| Status | Name | On | Freeze | Lock | Color | Linetype | Lineweight | Transparency | Plot Style | Plot |
|---|---|---|---|---|---|---|---|---|---|---|
| ✓ | 0 | | | | white | CONTINUOUS | Default | 0 | Color_7 | |
| | HS2_MAG_Grid_30m | | | | 11 | CONTINUOUS | Default | 0 | Color_11 | |
| | HS2_MAG_Grid_Border | | | | white | CONTINUOUS | Default | 0 | Color_7 | |
| | HS2_MAG_Agriculture_Drain | | | | 251 | TRACKS | Default | 0 | Color_251 | |
| | HS2_MAG_Agriculture_PloughEtc | | | | 35 | ACAD_ISO03W... | 0.25 mm | 0 | Color_35 | |
| | HS2_MAG_Agriculture_RidgeFurrow | | | | 35 | ACAD_ISO10W... | 0.25 mm | 0 | Color_35 | |
| | HS2_MAG_Archaeology | | | | 190 | CONTINUOUS | Default | 0 | Color_190 | |
| | HS2_MAG_Archaeology_Trend | | | | 190 | ACAD_ISO02W... | 0.25 mm | 0 | Color_190 | |
| | HS2_MAG_Archaeology_Zone_Ha... | | | | 190 | CONTINUOUS | Default | 0 | Color_190 | |
| | HS2_MAG_Archaeology_Zone_Ou... | | | | 255 | CONTINUOUS | Default | 0 | Color_255 | |
| | HS2_MAG_ArchaeologyPossible | | | | 161 | CONTINUOUS | Default | 0 | Color_161 | |
| | HS2_MAG_ArchaeologyPossible_T... | | | | 161 | ACAD_ISO02W... | 0.25 mm | 0 | Color_161 | |
| | HS2_MAG_ArchaeologyPossible_Z... | | | | 161 | CONTINUOUS | Default | 0 | Color_161 | |
| | HS2_MAG_ArchaeologyPossible_Z... | | | | 255 | CONTINUOUS | Default | 0 | Color_255 | |
| | HS2_MAG_Ferrous | | | | 9 | CONTINUOUS | Default | 0 | Color_9 | |
| | HS2_MAG_Ferrous_Zone_Hatch | | | | 253 | CONTINUOUS | Default | 0 | Color_253 | |
| | HS2_MAG_Ferrous_Zone_Outline... | | | | 255 | CONTINUOUS | Default | 0 | Color_255 | |
| | HS2_MAG_Industrial_BurntFired | | | | 14 | CONTINUOUS | Default | 0 | Color_14 | |
| | HS2_MAG_Natural_Hatch | | | | 84 | CONTINUOUS | 0.09 mm | 0 | Color_84 | |
| | HS2_MAG_Natural_OutlineHide | | | | 255 | CONTINUOUS | Default | 0 | Color_255 | |
| | HS2_MAG_OldFieldBoundary_Hat... | | | | 35 | CONTINUOUS | Default | 0 | Color_35 | |
| | HS2_MAG_OldFieldBoundary_Out... | | | | 255 | CONTINUOUS | Default | 0 | Color_255 | |
| | HS2_MAG_Pipe | | | | white | ACAD_ISO14W... | 0.40 mm | 0 | Color_7 | |
| | HS2_MAG_Uncertain | | | | 124 | CONTINUOUS | Default | 0 | Color_124 | |
| | HS2_MAG_Uncertain_Trend | | | | 124 | ACAD_ISO02W... | 0.25 mm | 0 | Color_124 | |
| | HS2_MAG_Uncertain_Zone_Hatch | | | | 124 | CONTINUOUS | Default | 0 | Color_124 | |
| | HS2_MAG_Uncertain_Zone_Outlin... | | | | 255 | CONTINUOUS | Default | 0 | Color_255 | |



# Annex D: Ecology – technical notes

1.1.1 The following technical notes are appended to this document:

- Ecological field survey methods and standards
- Ecological assessment method
- Methodology for demonstrating no net loss in biodiversity
- Ecological principles of mitigation

# HS2 London-West Midlands

# Ecology

# Technical note – Ecological field survey methods and standards

## A report to HS2 Ltd by Arup/URS

# Contents

## List of figures



## List of tables

**List of appendix tables**

# 1 Executive summary

1.1.1 This document contains methods for scoping and undertaking ecological surveys for a range of flora and fauna in support of the proposed High Speed Two London-West Midlands (HS2 LWM) scheme (hereafter the 'Proposed Scheme').

1.1.2 This document provides standard methodologies for those ecological surveys which will be conducted most frequently along the route of the Proposed Scheme in order to gather baseline information in support of the Ecological Impact Assessment (EcIA).

1.1.3 It is not intended to provide an exhaustive compendium of all survey methodologies utilised to inform the Environmental Statement (ES) for the Proposed Scheme. Where additional methodologies have been utilised in specific locations these details will be summarised in the ecology chapter of the appropriate Volume 2 Community Forum Area (CFA) reports, and detailed in the accompanying Volume 5 appendices.

# 2 Introduction

## 2.1 Purpose of the technical note

2.1.1 This technical note outlines proposals for the methods and standards to be adopted for baseline ecological field surveys in support of the Environmental Impact Assessment (EIA) for the construction of Phase 1 of Hs2, a new railway line between London and Birmingham (hereafter the 'Proposed Scheme').

2.1.2 This document contains methods for scoping and undertaking ecological surveys for a range of flora and fauna. It aims to ensure consistency of approach to field survey methods to ensure a robust and coherent EIA.

2.1.3 Surveys in support of the Ecological Impact Assessment (EcIA) baseline will be coordinated by multiple teams of ecological consultants. The following document has been prepared after internal discussion with the consultants commissioned to undertake field surveys and in response to feedback from Natural England and the Environment Agency.

2.1.4 This document sets out the key survey methodologies and data recording requirements for those field surveys which are considered most likely to be required to inform the ecological impact assessment. It is not intended to be an exhaustive list of surveys that will be conducted. Based on the scale of the proposed works it is likely that in some locations additional surveys, not detailed here, will be required. Where further surveys are conducted these will be listed in the ecology section of the appropriate Volume 2 Community Forum Area (CFA) reports, and detailed in the corresponding Volume 5 appendices.

2.1.5 The following document deals solely with field survey methodology and standards. Details of the proposed approach for associated desk study are reported within the Scope and Methodology Report (SMR) (Volume 5: Appendix CT-001-000/1) and the SMR Addendum (Volume 5: Appendix CT-001-000/2).

## 2.2 Land required for the construction of the Proposed Scheme

2.2.1 The extent of surveys required should in all situations take into consideration the most up to date information available regarding the extent of the land required for the construction of the Proposed Scheme[1]. For the purposes of the EcIA it is assumed that all land required for the construction of the Proposed Scheme will be lost. This assumption means that survey prescriptions within the land required have been based solely on likely ecological value of the habitats and species present, rather than likely impact.

2.2.2 As ecological survey commenced in spring 2012 prior to detailed engineering design, in the first instance the extent of the land required for the construction of the Proposed Scheme was assumed. As a consequence, survey extents are in general defined on the basis of buffers from the outer boundary of the land required for the construction of key elements (e.g. the operational railway, all associated infrastructure, site compounds and storage areas) of the Proposed Scheme (e.g. land

[1] Defined as all land that will be required to construct the Proposed Scheme i.e. all areas of land that will be directly affected by the Proposed Scheme, including that required for operation and that required solely during construction.

required + 100m). Due to an evolving design the desired survey extent has therefore altered throughout the period of survey (April 2012 –September 2013). With each design change survey scopes have been revised, and where necessary scoping for survey requirements updated. During 2013 where the extent of land required for the construction of the Proposed Scheme increased it was in some cases possible to rationalise the requirements for extending the extent of the prescribed buffer. The stability of the design at each location was considered in deciding if further extension of the survey extent was necessary in order to be sure all potential significant effects were identified. Professional judgement has been used where appropriate to rationalise the requirements for survey associated with ancillary works, generally those associated with diversions to services that extend away from the route of the Proposed Scheme. For example in many areas land has been included to facilitate minor pylon realignment. Such works may extend several kilometres from the route of the Proposed Scheme and may be unlikely to result in significant effects on ecological receptors. As a consequence, in each case an ecologist has reviewed the extent and nature of the works proposed and applied professional judgement to derive an appropriate survey effort for these elements of the scheme.

## 2.3 Screening for survey requirements (general)

2.3.1 Ecological consultants undertaking survey work to inform the ES are expected to utilise the approach and guidance provided in this document to identify where field surveys are required and what type of survey is appropriate.

2.3.2 Ecological field investigations should in the first instance be presumed to be required where:

- a potential ecological receptor is confirmed or it is thought there is a reasonable likelihood that such a receptor may be present; and
- significant effects on ecological integrity or conservation status may arise from the construction or operation of the Proposed Scheme.

2.3.3 Where access is available the presence of existing ecological data (either from biological records centres or pre-existing survey reports) should only be utilised to preclude the requirement for surveys specifically in support of HS2 where:

- it is clear that the survey methodology utilised is consistent with that proposed in this document and the data available; and
- the pre-existing data set is sufficiently up to date to still be considered valid (see SMR Addendum Volume 5: Appendix CT-001-000/1).

2.3.4 In all such cases a precautionary approach should be adopted and field survey repeated where there is any doubt over the validity of existing data.

2.3.5 Where surveys in support of another development require survey of the same areas of land the sharing of survey data may be required (e.g. to limit disturbance to a great crested newt breeding pond as a consequence of multiple surveys of the same water body). In all such cases, where there is a requirement to share data consultants should liaise with the project ecologists to ensure that the methods utilised are consistent with those specified in this document.

2.3.6 Due to an evolving design the required extent of surveys has varied over the period that surveys have been undertaken. Survey buffers established from the boundary of the land required for the construction of the Proposed Scheme have helped to limit the impact of design changes, as the majority of changes have led to extensions into areas which already fell within the required scope of surveys.

2.3.7 Guidance on the ecological assessment methodology is provided in the SMR (Volume 5: Appendix CT-001-000/1) and SMR Addendum (Volume 5: Appendix CT-001-000/2). Where a documented screening/scoping exercise has been conducted, and the outcome indicates that significant adverse effects on a potential ecological receptor are not likely to occur, reduced field survey effort, or scoping is likely to be appropriate.

2.3.8 Care should be taken to ensure that receptors potentially subject to indirect effects are also included within the survey scope. For example areas distant from the route of the Proposed Scheme which are potentially subject to impacts arising from hydrological changes.

## 2.4 Safety

2.4.1 The safety of the workforce and the public is paramount. Consultants undertaking field survey will be required to ensure that a health and safety risk assessment is in place prior to commencement of each field survey visit and to satisfy themselves that all appropriate access provisions are made.

2.4.2 All risk assessments should address key health and safety issues such as potential for slips, trips and falls; working in close proximity to water; working within fields occupied by livestock; working at height; potential exposure to asbestos; and night time working.

2.4.3 In particular, lone working is to be avoided unless consultants can demonstrate adequate safeguards are in place and the risk of harm is acceptable.

2.4.4 It is recognised that survey methods may need to be modified in some areas to allow surveys to be conducted safely, for example works on or near highways and railroads, or inspections of structurally unstable buildings. A record should be made of all such deviations.

## 2.5 Access to Land

2.5.1 All access to undertake field surveys will be organised by the land referencing team. A protocol for requesting and reporting upon access will be prepared and provided to consultants undertaking survey work.

2.5.2 Consultants undertaking survey work have been briefed on the acceptable use of Public Rights of Way (PRoW) during surveys.

## 2.6 Biosecurity

2.6.1 Field surveyors are to take all reasonable measures to ensure compliance with species specific best practice guidelines for preventing the spread of disease and of invasive species of flora and fauna.

2.6.2 This is particularly true of work in water. Current best practice bio-security measures are to be taken throughout, with disinfection of footwear and equipment between surveys, where they are used on more than one watercourse or water body. All amphibian surveys are to follow the guidelines for amphibian survey bio-security as set out in ARG-UK Guidance Note 4 (2008)[2].

## 2.7 Invasive non-native species

2.7.1 Where non-native animal species occurring on Part 1 Schedule 9 of the Wildlife and Countryside Act (1981 as amended)[3] are captured during the surveys in support of the project (in line with legislation) they will not be released back into the wild. Where such species are encountered (but not captured) during surveys the species and location will be recorded.

2.7.2 Where non-native animals which are not listed on Part 1 Schedule 9 of the Wildlife and Countryside Act (1981 as amended) are captured during surveys their presence will be noted on recording forms and individuals released.

2.7.3 Where plant species occurring on Part 2 Schedule 9 of the Wildlife and Countryside Act (1981 as amended) are encountered during habitat surveys the species, location and extent will be recorded.

## 2.8 Competency standards

2.8.1 Specific competency standards, qualifications and licensing are detailed for each survey type below where applicable. For surveys not dealt with in detail within the following document it is expected that consultants undertaking field surveys must meet the minimum relevant Chartered Institute of Ecology and Environmental Management (CIEEM) Competency for Species Survey (CSS) standards[4] which apply.

## 2.9 Combining surveys

2.9.1 Although the methodologies for the various surveys are described separately in this document, there is clearly scope for combining surveys and particularly screening to confirm the need to undertake specialist surveys.

2.9.2 Whilst combining surveys is encouraged where it is practical, it should not take place where this would result in a lack of adequate focus on particular surveys (e.g. survey for badger signs).

## 2.10 Identification of potential mitigation areas and receptor sites

2.10.1 During the process of screening and conducting field surveys consultants should consider the potential suitability of land within the vicinity of the prescribed survey extents to be utilised to provide mitigation or compensation, including use as receptor sites for protected species translocated from habitats lost as a consequence of the scheme.

[2] ARG-UK (2008) *ARG-UK Advice Note 4: Amphibian disease precautions: a guide for UK fieldworkers.* http://static.zsl.org/files/biosecurity-arguk4-511.PDF Accessed 18th July 2012.
[3] Wildlife and Countryside Act (1981) Chapter 69. Her Majesty's Stationery Office.
[4] CIEEM (2013) Competencies for species surveys in Britain and Ireland. http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/CSS/CSS_-_OVERVIEW_April_2013.pdf Accessed 02/10/2013.

2.10.2 Where ecologists identify potential receptor sites or mitigation areas they should submit details. This should include a brief rationale for their selection and proposals for any additional survey work they consider to be required to confirm the suitability of the identified sites for this purpose (e.g. reptile presence/absence survey).

## 2.11 Compliance and variations

2.11.1 Consultants undertaking field surveys should comply with the methods within this document, with deviations only permitted with approval from HS2 Technical Directorate and their overseeing consultants.

2.11.2 It is recognised that limitations in relation to access and health and safety may require a variation in survey scope and method. In particular, there could be access and timing restrictions beyond the control of the consultants. Close liaison between all parties will be required to identify as early as possible any limitations to the work and to discuss appropriate means to mitigate such constraints.

2.11.3 It is also recognised that in some areas (particularly suburban and urban areas), it will be appropriate to reduce the spatial scope defined in this document to reflect the fact that any potential significant effects in such areas are likely to be more closely associated with the route of the Proposed Scheme. For example in urban or suburban areas where large numbers of residential dwellings (which are to be retained) are present within the standard survey buffer, it is not anticipated that all such buildings will require internal inspection for bats.

2.11.4 In these situations consultants undertaking field surveys are expected to make judgements regarding the required spatial scope on a site by site basis and record the rationale for these decisions.

2.11.5 Where requirements arise for surveys not covered in this document, then discussion will be required between all teams of ecological consultants working on the project in order to ensure a consistent approach to survey.

## 2.12 References

ARG-UK (2008) ARG-UK Advice Note 4: Amphibian disease precautions: a guide for UK fieldworkers. http://static.zsl.org/files/biosecurity-arguk4-511.PDF Accessed 18th July 2012.

CIEEM (2013) Competencies for species surveys in Britain and Ireland. http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/CSS/CSS_-_OVERVIEW_April_2013.pdf Accessed 02/10/2013.

Wildlife and Countryside Act (1981) Chapter 69. Her Majesty's Stationery Office.

# 3 Survey referencing and recording (general)

## 3.1 Survey referencing

3.1.1 Survey information collected has been allocated an ecology survey code to provide a unique identifier for use on project mapping and within Geographical Information Systems (GIS):

Route zone code (3 digits) - Survey type code (3 digits) - Location reference code (6 digits) - (+ 3-digit record number reference where applicable – see Table 2)

3.1.2 The ecology survey codes and reference numbers are listed in Table 1 and

3.1.3 Table 2. The ecology site referencing code will form one of several identifier fields to be included in the final project wide GIS database.

Table 1: Route zone codes

| Section of the route | Route zone code |
|---|---|
| Community Forum Area 1 (CFA1) to CFA6 inclusive | 010 |
| CFA7 to CFA15 inclusive | 020 |
| CFA16 to CFA22 inclusive | 030 |
| CFA 23-26 inclusive | 040 |

Table 2: Survey type codes and reference numbers

| Survey | Survey type code | Location reference code | Use of 3-digit record number reference required |
|---|---|---|---|
| Amphibian - Aquatic survey (during mid-March to mid -une) | AA1 | 3 digit km no. + 3 digit site no. | No |
| Amphibian - Aquatic survey outside of the period mid-March to mid-June | AA2 | 3 digit km no. + 3 digit site no. | No |
| Amphibian – Habitat Suitability Index (HIS)/walkover | AH1 | 3 digit km no. + 3 digit site no. | No |
| Amphibian - Terrestrial survey (refuges only) | AT1 | 3 digit km no. + 3 digit site no. | No |
| Amphibian - Terrestrial survey (temporary amphibian fencing and pitfall traps/refuges) | AT2 | 3 digit km no. + 3 digit site no. | No |
| Badger - Field survey for signs of activity | BD1 | 3 digit km + 3 digit record no. | No |
| Badger - Extended field survey in support of territory analysis | BD2 | 3 digit km + 3 digit record no. | No |
| Badger - Field survey in support of bait marking exercise | BD3 | 3 digit km + 3 digit site no. | Yes |
| Bat - Initial assessment of structures including buildings, bridges and caves | BS1 | 3 digit km + 3 digit site no. | No |
| Bat - Further inspection of structures including buildings, bridges and caves | BS2 | 3 digit km + 3 digit site no. | No |
| Bat - Emergence survey of structures including buildings, bridges and caves | BS3 | 3 digit km + 3 digit site no. | No |

| Survey | Survey type code | Location reference code | Use of 3-digit record number reference required |
|---|---|---|---|
| Bat - Initial assessment of trees | BT1 | 3 digit km + 3 digit site no. | No |
| Bat - Further inspection of trees | BT2 | 3 digit km + 3 digit site no. | No |
| Bat – Emergence survey of trees | BT3 | 3 digit km + 3 digit site no. | No |
| Bat - Activity (transect) | BA1 | 3 digit km + 3 digit site no. | Yes |
| Bat - Activity (static detector) | BA2 | 3 digit km + 3 digit site no. | Yes |
| Bat - Activity (swarming) | BA3 | 3 digit km + 3 digit site no. | Yes |
| Bat - Activity (mist net/harp trapping/radio tracking) | BA4 | 3 digit km + 3 digit site no. | Yes |
| Bat – Hibernation | BH1 | 3 digit km + 3 digit site no. | No |
| Breeding bird - Discrete area/Common Birds Census | BB1 | 3 digit km + 3 digit site no. | Yes |
| Breeding bird – Habitat sampling | BB2 | 3 digit km + 3 digit site no. | Yes |
| Breeding bird - Species specific | BB3 | 3 digit km + 3 digit site no. | Yes |
| Ditch vegetation survey | DS1 | 3 digit km + 3 digit site no. | No |
| Fish survey | FI1 | 3 digit km + 3 digit site no. | Yes |
| Hazel dormouse – Habitat appraisal | HD1 | 3 digit km + 3 digit site no. | No |
| Hazel dormouse – Nest tube survey | HD2 | 3 digit km + 3 digit site no. | No |
| Hazel dormouse – Nut search | HD3 | 3 digit km + 3 digit site no. | No |
| Hedgerow survey | HS1 | 3 digit km + 3 digit hedge no. | No |
| Invertebrates - Aquatic survey | IA1 | 3 digit km + 3 digit site no. | No |
| Invertebrates - Terrestrial survey | IT1 | 3 digit km + 3 digit site no. | No |
| Otter – Habitat appraisal | OT1 | 3 digit km + 3 digit site no. | No |
| Otter – Detailed survey | OT2 | 3 digit km + 3 digit site no. | Yes |
| Pond survey (Rapid assessment method) | PS1 | 3 digit km + 3 digit site no. | No |
| Pond survey (Predictive SYstem for Multimetrics) | PS2 | 3 digit km + 3 digit site no. | No |
| Pond survey (National Pond Survey) | PS3 | 3 digit km + 3 digit site no. | No |
| Reptiles – Habitat appraisal | RE1 | 3 digit km + 3 digit site no. | No |
| Reptiles – Detailed survey | RE2 | 3 digit km + 3 digit site no. | No |

| Survey | Survey type code | Location reference code | Use of 3-digit record number reference required |
|---|---|---|---|
| River Corridor Survey | RS1 | 3 digit km + 3 digit site no. | No |
| River Habitat Survey | RS2/RH1 | 3 digit km + 3 digit site no. | No |
| Scoping survey | SCO | 3 digit km + 3 digit site no. | No |
| Water vole- Habitat appraisal | WV1 | 3 digit km + 3 digit site no. | No |
| Water vole – Detailed survey | WV2 | 3 digit km + 3 digit site no. | Yes |
| White-clawed crayfish – Habitat appraisal | WC1 | 3 digit km + 3 digit site no. | No |
| White-clawed crayfish – Manual search | WC2 | 3 digit km + 3 digit site no. | No |
| White-clawed crayfish – Trapping survey | WC3 | 3 digit km + 3 digit site no. | No |
| Wintering and passage birds – General | WB1 | 3 digit km + 3 digit site no. | Yes |
| Wintering and passage birds - Species specific | WB2 | 3 digit km + 3 digit site no. | Yes |
| Phase 1 habitat survey – Habitat parcel/feature | PH1 | 3 digit km + 3 digit habitat parcel ID | No |
| Vegetation (Phase 2 – National Vegetation Classification survey) | PH2 | 3 digit km + 3 digit site number | Yes – 3 digit habitat parcel ID |

3.1.4 The 6 digit location reference will follow the route and the numbering will sequentially increase. The route has been split into 1 km sections, each of which is allocated a three-digit km number. Surveys of each type conducted within that km of the route have then been sequentially numbered. So the first survey site in the first 1km section would have a location reference of 001001, the first site in the second 1km section would be 002001, and the first site in the 99th 1km section would be 099001.

3.1.5 Using these conventions, the third amphibian aquatic survey (conducted during mid-March to mid-June) location in the 200th 1km section within the zone including CFA17 would be:

- 030-AA1-200003

3.1.6 The 99th tree subject to initial assessment for bats in the 50th km in the zone including CFA9 would be:

- 020-BT1-050099

3.1.7 Where multiple survey visits are required at a discrete location (e.g. six amphibian visits to the same pond) then the results of all visits will be recorded under the single reference code for this survey location.

3.1.8 Where the extent of surveys is anticipated to be more continuous (e.g. hedgerow survey, Phase 1 habitat survey, badger survey), and therefore the concept of a site is redundant, the final three digits of the location reference field will be utilised to record the record number (e.g. target note number for Phase 1 habitat survey or field sign number for badger).

3.1.9 For example the 47th target note recorded during Phase 1 habitat survey in the 50th km in the zone including CFA11 would be:

- 020-PH1-050047

3.1.10 Note that for badgers at a sett location the sett itself should be allocated a record number. Details of individual entrances and other signs of activity associated with the sett (e.g. hairs and prints in entrances etc.) will all be described under a single six digit location reference. Where other field signs are identified away from a sett (e.g. latrine, hair on fence of badger path) these should be allocated a separate six digit location reference.

3.1.11 For some surveys it will be necessary to incorporate a fourth section to the code to allow both the site number and record number to be recorded. Surveys requiring this additional field within the referencing code are indicated in Table 2 above.

3.1.12 For example records of bat activity at the fourth listening station within the second bat activity transect route within the 54th km of the zone including CFA14 would be:

- 020-BA1-054002-004

3.1.13 Where repeat survey visits are conducted (e.g. repeat surveys of a bat activity transect) records from all surveys at the same location will be recorded under the same survey code.

# 4 Phase 1 (extended) habitat survey

## 4.1 Introduction and guidelines

4.1.1 Set out below are the methods to be used to map the habitats and vegetation present along the route of the Proposed Scheme. As the Phase 1 habitat survey is often the first opportunity to visit the route, also included is the requirement to search for and record signs of protected or otherwise notable species, and to assess habitats for their potential to support protected or otherwise notable species, as well as invasive species of flora and fauna. This information will be used as part of the decision process for targeting future surveys.

## 4.2 Qualifications and experience

4.2.1 Surveyors are to be experienced in Phase 1 habitat survey, be competent botanists and have previously undertaken surveys in the types of habitats likely to be present. For extended[5] Phase 1 habitat survey, surveyors will also be experienced in the identification of potential for habitats to support protected or otherwise notable species (including badger, otter, hazel dormouse, bats etc.).

## 4.3 Licensing requirements

4.3.1 There are no licensing requirements for Phase 1 habitat survey.

[5] Extended Phase 1 habitat survey is the traditional survey of botanical habitats extended to include an evaluation of the potential of the habitats to support protected or otherwise notable species.

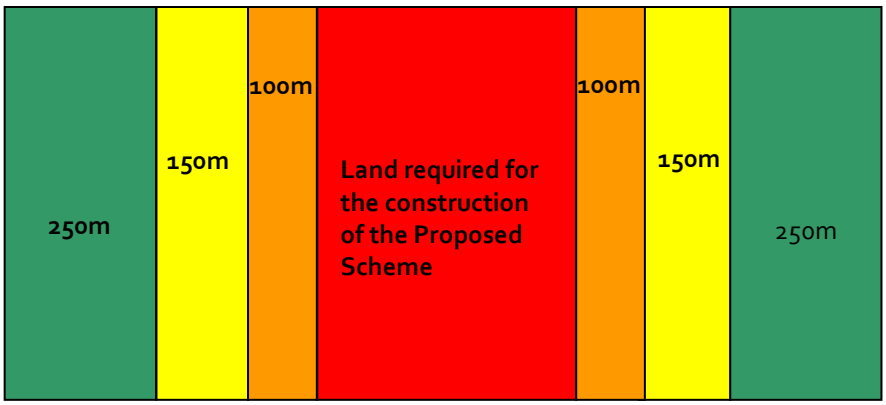
## 4.4 Screening for survey and defining the survey area

4.4.1 Subject to access restrictions, Phase 1 habitat survey and mapping is required for the entire London-West Midland route within the survey buffers defined below.

4.4.2 As a minimum (subject to the caveats identified in Section 2.11) consultants will be required to produce a set of route maps identifying habitat types within a 500m buffer of the land required for the construction of the Proposed Scheme. The level of field survey required is not the same across the whole 500m buffer either side of the land required, but is zoned according to likely impacts, as described below.

4.4.3 The diagram below shows the standard division of zones within the 500m buffer beyond the boundary of the land required for the construction of the Proposed Scheme.

Figure 1: Standard extents of Phase 1 habitat survey




4.4.4 In rural areas, within the land required for the construction of the Proposed Scheme and 100m either side, the level of survey should, as a minimum, follow the full, extended Phase 1 habitat survey method.

4.4.5 Within a zone extending to a further 150m (i.e. 101-250m from the boundary of the land required for the construction of the Propose Scheme), a "classic" Phase 1 habitat survey will be undertaken. In this zone, therefore, it is sufficient to map broad habitat types and make target notes of any features of interest.

4.4.6 From 250m to 500m from the boundary of land required for the construction of the Proposed Scheme the habitats will be mapped from aerial photograph interpretation alone and there will be no requirement to undertake a field-based Phase 1 habitat survey. However, where possible a note should be made of any obvious changes in habitat type from that shown from interpretation of aerial photographs e.g. woodland felled; hedgerow removed; improved grassland now under arable cultivation.

4.4.7 In urban areas the survey zones are likely to be restricted in extent and for many areas limited to the route and areas with public access. Where feasible, up to 100m from the route, the level of survey should follow the full extended Phase 1 habitat survey method but as a minimum, a note should be made of any obvious changes in habitat type from that shown from interpretation of aerial photographs.

4.4.8 Following initial site visits and mapping it may be necessary to revisit and modify the survey zones locally in order to capture sufficient information to inform the scope of other investigations and assess likely significant effects. For example, the 100m

survey zone may be expanded to include the whole of a sensitive habitat that is within, but extends beyond the 100m zone described above.

4.4.9 The approach described shall be principally applied in relation to the land required for the construction of the key elements (e.g. the operational railway, all associated infrastructure, site compounds and storage areas) of the Proposed Scheme.

4.4.10 Professional judgement has been used where appropriate to rationalise the requirements for survey associated with ancillary works, generally associated with diversions to services that extend away from the route of the Proposed Scheme.

## 4.5 Survey methods

4.5.1 The survey is to be undertaken following the published methodology for Phase 1 habitat survey (Joint Nature Conservation Committee, 2010)[6] and Guidelines for Preliminary Ecological Appraisal (Institute of Ecology and Environmental Management, 2012)[7]. This includes mapping the habitat type according to the definitions in the Handbook for Phase 1 habitat survey (Joint Nature Conservation Committee, 2010); noting dominant species; and providing target notes where appropriate to identify particular features/species.

4.5.2 Information on habitats and species composition to be collected during Phase 1 habitat survey has, as far as possible, to be sufficient for an assessment to be made as to requirements for further survey (e.g. National Vegetation Classification ).This will apply within the land required for the construction of the Proposed Scheme and a 100m-wide "buffer zone" but further from the land required consultants undertaking field survey are to determine whether such surveys could be required, depending on the value and sensitivity of the habitat (and associated species of flora and fauna) and the nature of the impacts predicted to result from the Proposed Scheme.

4.5.3 Target notes should be used to identify modified habitats such as low diversity/value road verge grasslands, to distinguish them from unimproved or other higher value habitats.

4.5.4 Invasive plant species such as Japanese knotweed are to be mapped as 'tall ruderal' with associated target notes

4.5.5 In addition, the Phase 1 habitat survey is to be extended to include recording signs of and suitability for protected/notable species according to methods in Guidelines for Baseline Ecological Assessment (Institute of Environmental Assessment, 1995)[8]. Such signs and features should be accurately located on a plan and GPS coordinate(s) recorded.

4.5.6 Where no access is available for survey, any existing data and review of aerial photography should be used to allocate areas to Phase 1 habitat codes.

## 4.6 Survey programme and effort

4.6.1 Species associated with different habitats are more easily identified at various times in the growing season. In order to identify most habitats accurately, Phase 1 habitat

[6] Joint Nature Conservation Committee (2010), *Handbook for Phase 1 habitat survey - a technique for environmental audit*. Peterborough.
[7] Institute of Ecology and Environmental Management (2012). *Guidelines for preliminary ecological appraisal*. Institute for Ecology and Environmental Management. http://ieem.net/
[8] Institute of Environmental Assessment (1995), *Guidelines for Baseline Ecological Assessment*. E and FN Spon, London.

survey should ideally be undertaken between April and early October. However, in order to prevent delay in the identification of protected species constraints, in all cases Phase 1 habitat survey should be completed as early as access is forthcoming (i.e. even when outside of the April to early October window), and repeated during the following optimum window for habitat survey where required.

4.6.2 For some habitats (e.g. areas dominated by amenity grassland, hard standing or buildings), it will be possible to gather sufficient information of value outside the April to early October window, and no repeat survey will be required. In these situations consultants should make a clear record in each case of why survey information collected outside of the optimum window is considered to represent a valid survey.

## 4.7 References

Institute of Environmental Assessment (1995). Guidelines for Baseline Ecological Assessment. E and FN Spon, London

Institute of Ecology and Environmental Management (2012). Guidelines for preliminary Ecological Appraisal. Institute for Ecology and Environmental Management.

Joint Nature Conservation Committee (2010). Handbook for Phase I Habitat Survey: A technique for environmental audit. Joint Nature Conservation Committee, Peterborough

# 5 National Vegetation Classification survey

## 5.1 Introduction and guidelines

5.1.1 Habitats identified at the Phase 1 stage as being particularly species diverse and/or sensitive, of a type restricted in the UK/Region, and which could be directly or indirectly affected by the Proposed Scheme are likely to require further survey to Phase 2 National Vegetation Classification (NVC) level.

5.1.2 Where it is identified that Phase 2 (NVC) surveys are required, the survey methods are as a general rule to follow the published methodology appropriate to the vegetation being surveyed (Rodwell, 1991 et seq)[9] and Rodwell (2006)[10].

5.1.3 Reference should also be made to National Vegetation Classification: User's Handbook (Rodwell et al, 2000)[11] and the web site of the Joint Nature Conservation Committee http://jncc.defra.gov.uk/page-4259 where up-to-date information can be obtained regarding changes/additions to the vegetation types presented in the original published volumes.

5.1.4 It is acknowledged that in some habitats NVC may not represent the most appropriate method of Phase 2 vegetation survey to provide quantitative data in support of impact assessment. In all such cases a deviation request should be submitted.

## 5.2 Qualifications and experience

5.2.1 Surveyors are to be competent botanists and experienced in undertaking Phase 2 (NVC) surveys across the range of habitats likely to be encountered .

## 5.3 Licensing requirements

5.3.1 There are no licensing requirements for Phase 2 (NVC) survey.

## 5.4 Screening for survey and defining the survey area

5.4.1 The results of the desk study and/or the Phase 1 habitat survey should be used along with consideration of the nature, location and extent of the habitat within the land required for the construction of the Proposed Scheme and surrounding land to identify areas for survey to NVC level.

5.4.2 Habitats that are likely to require survey at Phase 2 include ones where there are:

- potential significant direct or indirect effects on designated statutory and non-statutory wildlife sites; and/or
- potentially significant effects on habitats of principal importance identified within Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006)[12] . As a guide, areas of greater than 1ha in area are more likely to

[9] Rodwell, J.S. (1991 et seq), *British Plant Communities*. Publication in Five Volumes. Cambridge University Press. Cambridge.
[10] Rodwell, J.S. (2006), *National Vegetation Classification: User's handbook*. Joint Nature Conservation Committee. Peterborough. Downloadable at http://jncc.defra.gov.uk/pdf/pub06_NVCusershandbook2006.pdf Accessed 10/04/2012.
[11] Rodwell. J.S., Dring., J.C., Averis, A.B.G., Proctor, M.C.F., Malloch, A.J.C., Schaminee, J.H.J. and Dargie, T.C.D. (2000). *Review of coverage of the National Vegetation Classification*. Joint Nature Conservation Committee, Peterborough.
[12] *Natural Environment and Rural Communities Act* (1996), Chapter 16. Her Majesty's Stationery Office, London.

require NVC survey but the consultants undertaking field survey should decide whether areas smaller than this should also be surveyed on a case-by-case basis depending on habitat quality and complexity. It should be noted that even where significant effects are anticipated NVC survey will not be appropriate for all extents of habitats of principal importance (e.g. reedbed);

- potential significant direct effects on other habitats considered to be particularly high quality/value examples of their type or likely to contain uncommon plant species; and/or
- potential indirect impacts on extensive wetland areas.

5.4.3 Where a discrete survey area is not easily determined (for example, where a habitat extends beyond the Phase 1 habitat survey area), comparative data are likely to be required from the wider extent (potentially the whole extent of the habitat 'unit') to enable an assessment of the scale of impact from the development. This will be decided on a case-by-case basis by the consultants undertaking the survey.

## 5.5 Survey method

5.5.1 At each site identified for survey, homogenous stands of vegetation are to be identified and sampled with a minimum of five quadrats, size appropriate to the vegetation being surveyed (see Rodwell 1991 et seq. or Rodwell, 2006). Quadrats are to be recorded in typical vegetation and are not required to be random or evenly spread.

5.5.2 Where woodland is encountered and is directly impacted by the route, it is expected that NVC level data will be collected. Guidance for sampling woodlands is given in Rodwell (2006). Within small woodland blocks it is likely that five 50m x 50m samples cannot be taken and the whole stand can be the quadrat for canopy and understorey but within such areas replicate 4m x 4m or 10m x 10m quadrats can be recorded for the field and ground layers and then combined.

5.5.3 Within each quadrat all species are to be recorded with an estimate of percentage cover/abundance using the Domin scale (1 = few individuals; 2 = some individuals; 3 = many individuals; 4 = 4% - 10%; 5 = 11% - 25%; 6 = 26% - 33%; 7 = 34% - 50%; 8 = 51% - 75%; 9 = 76% - 90%; 10 = 91% - 100%). Subsequent areas of the same vegetation within a site do not require five additional quadrats but should be sampled for consistency and at least one quadrat recorded and, based on size, possibly more at the discretion of the surveyor.

5.5.4 The location of each quadrat should be recorded accurately on a plan and a GPS coordinate taken.

5.5.5 Voucher specimens should be taken for species for which identification may be contentious, including some bryophytes and lichens.

5.5.6 A sketch plan of the whole area surveyed should be made and a record made of physical parameters including slope and aspect (see Rodwell, 2006) where necessary to allow assessment of significant effects. Consultants undertaking field surveys should also consider whether pH and soil depth data are required to assess effects on the vegetation.

## 5.6 Data analysis

5.6.1 The data collected is to be analysed to provide the 'best' approximation to a published NVC type.

5.6.2 The data recorded in the quadrats from each homogenous stand of vegetation are to be tabulated and a constancy value for each species calculated for each defined group of quadrats, as follows:

- Scale: I = 1% - 20%. II = 21% - 40%. III = 41% - 60%. IV = 61% - 80%. V = 81% - 100%.

5.6.3 The tables produced will then be used to assign the vegetation types to one of the published plant community types through use of the keys provided in the published volumes and by visual comparison of the collected data with the published data. In addition, there are also computer programs (MATCH or TABLEFIT) that can be used to facilitate comparison of the data sets with published data. Alternative software should not be utilised without prior approval.

## 5.7 Survey programme and effort

5.7.1 The accurate definition of plant communities requires comprehensive species lists, including grasses and lower plants. As far as possible, Phase 2 surveys should therefore take place when most species, and particularly any characteristic species, are at their most visible. For most habitats, this will cover the period May to July.

## 5.8 References

Natural Environment and Rural Communities Act (1996) Chapter 16. Her Majesty's Stationery Office, London.

Rodwell, J.S. (1991 et seq). British Plant Communities. Published in Five Volumes. Cambridge University Press, Cambridge.

Rodwell, J.S. (2006). National Vegetation Classification: User's Handbook. Joint Nature Conservation Committee, Peterborough. Downloadable at http://jncc.defra.gov.uk/pdf/pub06_NVCusershandbook2006.pdf Accessed: 10/04/2012.

Rodwell, J.S., Dring, J.C., Averis, A.B.G., Proctor, M.C.F., Malloch, A.J.C., Schaminee, J.H.J. and Dargie, T.C.D. (2000). Review of Coverage of the National Vegetation Classification. Joint Nature Conservation Committee, Peterborough.

# 6 River Habitat Survey

## 6.1 Introduction and guidelines

6.1.1 River Habitat Survey (RHS) is a method designed to characterise and assess, in broad terms, the physical structure of freshwater streams and rivers.

6.1.2 The proposed approach will follow the survey methodology outlined within River Habitat Survey in Britain and Ireland; Field Survey Guidance Manual; Version 3 (Environment Agency, 2003)[13]. River Corridor Survey (RCS) will be conducted on the same sections of watercourse, and details of this methodology are provided within Section 7.

6.1.3 RHS is carried out along a standard 500m length of river channel. Observations are made at ten equally spaced spot-checks along the channel, whilst information on valley form and land-use in the river corridor provides additional context. (Environment Agency, 2003).

## 6.2 Qualifications and experience

6.2.1 All initial scoping and subsequent field survey should be conducted by persons who have attended training in the 2003 Version of the Environment Agency methodology and passed an accreditation test.

## 6.3 Licensing requirements

6.3.1 There are no licensing requirements for RHS.

## 6.4 Screening for survey and defining the survey area

6.4.1 The desk study will identify watercourses identified as "main" rivers and the results of the Phase 1 habitat survey will indicate the nature of any other watercourses. Lengths of a watercourse should be surveyed if:

- the watercourse is defined as "main" river; or
- the watercourse has flowing water and a channel width of more than 1m;
- the watercourse is not obviously canalised or heavily managed; and
- the watercourse is to be lost/culverted/diverted or potentially experience a significant change in water quality or quantity that could affect the flora and fauna within the watercourse and/or designated wildlife sites downstream.

6.4.2 At each location selected for survey the survey will as a minimum cover a 500m section of the watercourse centred on the centreline of the route of the Proposed Scheme (i.e. 250m either side of the route). Consultants undertaking survey should consider the need to extend this to incorporate further 500m sections at those locations where this extent does not include as a minimum the land required for the construction of the Proposed Scheme and a 100m buffer either side of the boundary

[13] Environment Agency (2003), Riv*er Habitat Survey in Britain and Ireland. Field Survey Guidance Manual; 2003 Version*. Environment Agency, Bristol.

of the land required, or watercourse diversions are proposed and there is considered to be the potential for likely significant effects further upstream or downstream.

## 6.5 Survey Methods

6.5.1 The survey should be undertaken according to the methodology provided in River Habitat Survey in Britain and Ireland; Field Survey Guidance Manual; Version 3 (Environment Agency, 2003).

6.5.2 Results should be recorded using the standard 2003 Version survey forms with the survey unique reference recorded (following the conventions shown in Section 3) within the survey number/site reference fields.

## 6.6 Survey programme and effort

6.6.1 Where possible RHS surveys should be undertaken during the months of May or June, in order to avoid vegetation obscuring channel features.

6.6.2 Where emergent and bankside vegetation is limited, or regularly managed then survey may be suitable over a much longer season. Where surveys are undertaken outside of the non-optimal months of May and June, subsequent interpretation of the results should take into account the seasonal aquatic and bankside vegetation growth (Environment Agency, 2003).

6.6.3 High water levels and turbidity will also obscure many of the features RHS is designed to record (Environment Agency, 2003). Survey should therefore not be conducted during periods following periods of heavy rain and should be delayed until water level and turbidity have returned to acceptable levels.

## 6.7 References

Environment Agency (2003) River Habitat Survey in Britain and Ireland. Field Survey Guidance Manual; 2003 Version. Environment Agency, Bristol.

# 7 River Corridor Survey

## 7.1 Introduction and guidelines

7.1.1 River Corridor Survey (RCS) will be conducted in accordance with published guidance (National Rivers Authority, 1992)[14]. River Habitat Survey (RHS) (Environment Agency, 2003)[15] will be conducted on the same sections of watercourse, and details of this methodology are provided within Section 6.

7.1.2 Invertebrate surveys of affected watercourses may also be a requirement. The methods for these are provided in Section 20.

## 7.2 Qualifications and experience

7.2.1 The surveyors must be experienced in undertaking RCS. Where boats are to be used, they should be manned by appropriately trained/certificated boat handlers and surveyors should all have received adequate training in surveying from a boat.

## 7.3 Licensing requirements

7.3.1 There are no licensing requirements for the RCS but training is available by undertaking the course run by the Environment Agency.

## 7.4 Screening for survey and defining the survey area

7.4.1 The desk study will identify watercourses identified as "main" rivers and the results of the Phase 1 habitat survey will indicate the nature of any other watercourses. Lengths of a watercourse should be surveyed if:

- the watercourse is defined as "main" river; or
- the watercourse has flowing water and a channel width >1m; and
- the watercourse is not obviously canalised or heavily managed; and
- the watercourse is to be lost/culverted/diverted or potentially experience a significant change in water quality or quantity that could affect the flora and fauna within the watercourse and/or designated wildlife sites downstream.

7.4.2 The survey will at each location cover a minimum 500m section of watercourse centred on the proposed route (i.e. 250m either side of the route). Consultants undertaking survey work should consider the need to extend this further at those locations where this extent does not include at least a 100m buffer either side of the boundary of land required for the construction of the Proposed Scheme or watercourse diversions are proposed and there is considered to be the potential for likely significant effects further upstream or downsteam.

[14] National Rivers Authority (1992), *River Corridor Surveys. Conservation Technical Handbook Number 1.*
[15] Environment Agency (2003), *River Habitat Survey in Britain and Ireland.* Field survey Guidance Manual: 2003 Version. Environment Agency, Bristol.

## 7.5 Survey method

7.5.1 The survey will be undertaken and recorded using the published methodology (National Rivers Authority, 1992), with an annotated map forming the basis of the survey output.

7.5.2 GPS coordinates are to be recorded at the beginning and end of each survey section.

## 7.6 Survey programme and effort

7.6.1 Where possible, the survey should be undertaken during the period May - September. This allows adequate survey of the aquatic flora and also survey at the time when high water levels or spate conditions are least likely to occur. Where conducted outside of this period, particular care should be taken to record any limitations to the interpretation of the results obtained.

## 7.7 References

Environment Agency (2003) River Habitat Survey in Britain and Ireland. Field Survey Guidance Manual; 2003 Version. Environment Agency, Bristol.

National Rivers Authority (1992). River Corridor Surveys. Conservation Technical Handbook Number 1.

# 8 Hedgerows survey

## 8.1 Introduction and guidelines

8.1.1 The survey of hedgerows may be undertaken concurrently with the Phase 1 habitat survey but there are specific details to record over and above that usually recorded at Phase 1 level.

8.1.2 Please refer to the Hedgerows Regulations 1997[16] for the full definition and for survey methods.

## 8.2 Qualifications and experience

8.2.1 Surveyors are to be experienced in Phase 1 habitat survey and able to identify woody hedgerow species and woodland ground flora.

## 8.3 Licensing requirements

8.3.1 There are no licensing requirements for hedgerow survey.

## 8.4 Screening for survey and defining the survey area

8.4.1 All hedgerows that fall within or partly within the land required for the construction of the Proposed Scheme and a surrounding 100m buffer are to be surveyed to comply with the requirements of the "Wildlife and Landscape Criteria" in the Hedgerows Regulations (1997). Survey should not be limited to just those hedgerows that are more than 30 years old. However, hedgerows that have obviously been recently planted (e.g. tree guards and stakes still present) may be excluded.

8.4.2 It is recognised that full surveys for all potential fauna species are unlikely to be necessary for all hedgerows; assessment and requirements for further survey is to be based upon the desk-study results and outcomes of the habitat appraisal for protected and notable species.

8.4.3 Hedgerows that fall wholly outside a 100m buffer from the boundary of the land required for the construction of the Proposed Scheme, but which at least partly fall within a buffer of 100-250m should be noted, a list of woody species made and an estimate of general height and width given.

8.4.4 Hedgerows more than 250m from the boundary of the land required for the construction of the Proposed Scheme are unlikely to require full survey. Location of hedgerows will be captured by Phase 1 habitat survey conducted from aerial photographs. Where possible field surveys should seek to confirm that these hedgerows remain present.

## 8.5 Survey method

8.5.1 Survey is to comply with the requirements of the "Wildlife and Landscape Criteria" in the Hedgerow Regulations 1997.

[16] *The Hedgerows Regulations* (1997). SI1997 No 1160. Her Majesty's Stationery Office.

8.5.2 Depending on length, this involves recording the number of woody species along at least one typical 30m section and recording associated data including hedgerow height and width, number of mature trees, ditch, bank etc.

8.5.3 The start and end points of each hedgerow are to be recorded with at least an 8 figure OS grid reference using GPS.

8.5.4 The total number of other hedgerow connections to the hedgerow being surveyed should also be recorded, as recommended in the Defra Hedgerow Survey Handbook (Defra, 2007)[17].

8.5.5 Hedgerows are to be recorded and mapped with a unique ecology survey code attributed, following the general description given in Section 3. It is helpful to map hedgerows from aerial photography in advance of survey so that survey sections and nodes can be identified.

## 8.6 Survey programme and effort

8.6.1 The survey of the hedgerows is ideally to be undertaken within the timescales required to adequately record both woody vegetation and ground flora.

## 8.7 References

Department for Environment, Food and Rural Affairs (2007). Hedgerow Survey Handbook. A Standard Procedure for local surveys in the UK. Defra, London.

The Hedgerows Regulations (1997). Statutory Instrument 1997 No 1160. Her Majesty's Stationery Office.

[17] Department for Environment, Food and Rural Affairs (2007), *Hedgerow Survey Handbook*. A Standard Procedure for local survey in the UK. Defra, London.

# 9 Ditch vegetation survey

## 9.1 Introduction and guidelines

9.1.1 The method to be used to survey the vegetation of ditches is that published in A Manual for the Survey and Evaluation of the Aquatic Plant and invertebrate Assemblages of Ditches Version 4, (Buglife, 2010)[18]. This is based on an earlier methodology (Alcock and Palmer, 1985)[19].

9.1.2 This methodology has been utilised to provide a uniform approach to obtaining data. It is acknowledged that the method was devised for use in grazing marsh and as such the evaluation of conservation value will not use the criteria which form part of the methodology.

9.1.3 The methodology for the selection and sampling of ditches for invertebrate assemblages is provided in Section 20.

## 9.2 Qualifications and experience

9.2.1 Surveyors are to be competent botanists and experienced in undertaking standardised vegetation surveys.

## 9.3 Licensing requirements

9.3.1 There are no licensing requirements for the ditch survey.

## 9.4 Screening for survey and defining the survey area

9.4.1 The results of the Phase 1 habitat survey will indicate the nature of ditches. The surveyor is to judge whether a ditch requires additional survey work in order to assess significant effects. As a guide, further survey is likely to be required where a ditch:

- is likely to hold permanent water; and
- has not been heavily managed; and
- supports a diverse and/or otherwise notable aquatic, emergent and marginal flora that cannot be adequately described by Phase 1 habitat survey; and
- is likely to be subject to significant effects due to habitat loss/culverting/diversion or experience a significant change in water quality or quantity.

9.4.2 The requirement for survey is likely to be limited to ditches that fall within or partly within the land required for the construction of the Proposed Scheme and surrounding 100m buffer. Only in exceptional circumstances is it envisaged that survey will be required beyond the 100m buffer. This is likely to be where the ditch network is extensive and part of a large wetland complex. Where there is a complex of ditches, more extensive survey may be required to assess effects on to the wider network,

[18] Buglife – The Invertebrate Conservation Trust (2012), A Manual for the Survey and Evaluation for the Aquatic Plant and UInvertebrate Assemblages ofDditches. Version 4, December 2010.
[19] Alcock, M.R. and Palmer, M.A. (1985), A standard method for the survey of ditch vegetation CST Notes No.37. Nature Conservancy Council, Peterborough.

though sampling rather than survey of every ditch may be sufficient. Judgement is to be made by the surveyors on a case-by-case basis.

## 9.5 Survey method

9.5.1 A representative 20m section of ditch is chosen for the detailed survey described in 9.5.2 and the whole ditch (as far as access allows) should be surveyed to list other plant species. If the nature of the ditch changes, then further sections are surveyed as necessary. All plants growing in the ditch and on the banks up to the top of the bank are recorded to species level wherever possible, along with their abundance on the DAFOR scale (Dominant, Abundant, Frequent, Occasional or Rare).

9.5.2 As well as vegetation, the following parameters are measured/assessed, as described in the manual:

- adjacent land-use;
- ditch features, bank top width, freeboard, bank angles (above and below water level), water depth, silt depth, water width;
- a cross-section description (sketch);
- conductivity, pH, turbidity, water colour; and
- vegetation cover, grazing/vegetation cover, management.

9.5.3 A standard recording form is completed for each surveyed section.

## 9.6 Survey programme and effort

9.6.1 Where possible, ditches selected for further survey should be surveyed in the period June to the end of July for ease of identification of plant species but May and August are also often acceptable months.

9.6.2 Where survey has been undertaken outside of the periods identified in 9.6.1 the limitations should be identified and discussed to place any results obtained into context.

## 9.7 References

Alcock, M.R. and Palmer, M.A. (1985). A standard method for the survey of ditch vegetation. CST Notes No. 37. Nature Conservancy Council, Peterborough.

Buglife - The Invertebrate Conservation Trust (2010). A Manual for the Survey and Evaluation of the Aquatic Plant and invertebrate Assemblages of Ditches. Version 4 December 2010.

# 10 Pond survey

## 10.1 Introduction and guidelines

10.1.1 Methods for detailed survey of ponds are based on the methods developed by the Pond Conservation Trust. Details of the methods in the National Pond Monitoring Network can be found at http://www.pondconservation.org.uk/Data/aboutnpmn.

10.1.2 The method to be used will depend on the preliminary assessment from the Phase 1 habitat survey, the location of the pond in relation to the route and whether the pond is to be lost. All methods involve sampling of the aquatic macro-invertebrate fauna, with some also requiring botanical survey, as well as measurement of physical and chemical parameters.

## 10.2 Qualifications and experience

10.2.1 Surveyors are to be competent and experienced in undertaking aquatic macro-invertebrate surveys and in botanical identification. There is also a requirement for personnel who can identify invertebrate specimens to the taxonomic level appropriate to the method used but this does not have to be in the field and can be laboratory-based.

## 10.3 Licensing requirements

10.3.1 There are no licensing requirements for the pond survey unless the surveyor considers that the survey methods could affect protected species utilising the pond.

## 10.4 Screening for survey and defining the survey area

10.4.1 The results of the Phase 1 habitat survey will identify and provide an initial description of ponds.

10.4.2 Ponds are to be subject to further survey where a pond is likely to experience significant effects and where the pond:

- holds water for four consecutive months or longer; and
- has not been heavily managed; and
- supports a diverse or otherwise notable aquatic, emergent and marginal flora.

10.4.3 Where the pond is likely to be lost or significantly affected then it should be subject to a survey using the Predictive SYstem for Multimetrics (PSYM)[20] or National Pond Survey (NPS)[21] methodology, with the NPS method limited to ponds with the most diverse and/or notable flora, and which, in the professional opinion of the surveyor, cannot be adequately assessed using PSYM. Ponds not threatened with loss and only minor effects should be subject to the rapid assessment method.

10.4.4 Ponds for survey will lie within the land required for the construction of the Proposed Scheme or within a 100m buffer. The consultant undertaking field surveys should also

[20] Pond Action (2002), A Guide to Monitoring the Ecological Quality of Ponds and Canals Using PSYM. Pond Action, Oxford.
[21] Pond Action (1998), *Guide to the Methods of the National Pond Survey*. Pond Action, Oxford.

assess whether any ponds outside this area also need to be surveyed, based on the likelihood of significant effects.

## 10.5 Survey methods

### Rapid assessment method

10.5.1 The rapid assessment for ponds requires invertebrate sampling only and is a rapid assessment of "naturalness" using invertebrate diversity and families similar to the Biological Monitoring Working Party system for running water.

### PSYM

10.5.2 The Predictive SYstem for Multimetrics (PSYM) method includes collection of physical data, invertebrate sampling and plant recording (Pond Action, 2002)[22]. These data are used to undertake an analysis to compare the pond against a national database held by the Pond Conservation Trust (PCT). The data are submitted to PCT for analysis.

### National Pond Survey

10.5.3 The National Pond Survey (NPS) method provides the most detailed assessment of a pond and includes environmental and chemical data from the pond in addition to plant and invertebrate survey (Pond Action, 1998)[23].

## 10.6 Survey programme and effort

10.6.1 The survey should be undertaken in accordance with the programme recommended in the relevant survey guidelines.

## 10.7 References

Pond Action (1998). Guide to the Methods of the National Pond Survey. Pond Action, Oxford.

Pond Action (2002). A Guide to Monitoring the Ecological Quality of Ponds and Canals Using PSYM. Pond Action, Oxford.

[22] Pond Action (2002), *A Guide to Monitoring the Ecological Quality of Ponds and Canals Using PSYM*. Pond Action, Oxford.
[23] Pond Action (1998), *Guide to the Methods of the National Pond Survey*. Pond Action, Oxford.

# 11 Amphibians (great crested newt)

## 11.1 Introduction and guidelines

11.1.1 The Proposed Scheme has the potential to result in adverse effects on populations of amphibians as a consequence of loss and/or disturbance of breeding ponds, loss of terrestrial habitat and severance/fragmentation of habitat. Of particular importance are impacts with the potential to affect great crested newt (*Triturus cristatus*).

11.1.2 The survey approach is based on guidance provided within Great Crested Newt Mitigation Guidelines (English Nature, 2001)[24], and Natural England's European Protected Species Mitigation Licence (EPSML) application template WML-A14-2 Version March 2011[25].

11.1.3 The survey methods employed will vary depending on the likely impact to a population utilising the water body in question. Where initial visits confirm the presence of great crested newt, further visits should be undertaken in order to provide an estimate of the size of the population using the pond.

11.1.4 Where the seasonal timing of surveys is constrained by access, then non-standard methods will be utilised where appropriate to confirm presence; such methods should not be utilised to assume likely absence.

## 11.2 Qualifications and experience

11.2.1 Surveyors should be experienced in conducting pond surveys and habitat suitability assessment, and able to identify confidently all relevant amphibian species.

## 11.3 Licensing requirements

11.3.1 Amphibian surveys in support of the scheme will involve survey of large numbers of water bodies. As such survey is anticipated to involve work by a large number of licensed surveyors.

11.3.2 In all cases survey within a specific geographical area will be coordinated by a holder of a Natural England licence to take and disturb great crested newt (for the purposes of science and conservation) with experience of co-ordinating large scale surveys.

11.3.3 Ideally, at least one of the two persons within any survey team will be a holder of a Natural England scientific licence to take and disturb great crested newt. Use of accredited agents to lead pond survey visits (i.e. a team of two accredited agents working together) will only be acceptable where a curriculum vitae demonstrating their suitability for this role is submitted and approved by the overseeing consultants.

11.3.4 If survey of terrestrial habitat which would require use of pitfall trapping is required then an application will be submitted to Natural England.

[24] English Nature (2001), *Great Crested Newt Mitigation Guidelines*. English Nature, Peterborough.
[25] Natural England (2013), *Great crested newt method statement Template WML-A14-3 Version April 2013* downloaded at http://www.naturalengland.org.uk/Images/wml14-2_tcm6-4103.xls on 2 October 2013.

## 11.4 Screening for survey and defining the survey area

### Desk based scoping exercise

11.4.1 A desk based scoping exercise to identify those water bodies requiring amphibian survey, and the likely appropriate survey effort was undertaken in spring 2012 and has been updated periodically in order to take account of on-going changes to the design and extent of land required for the construction of the Proposed Scheme.

11.4.2 For the purpose of scoping all impacts on habitats were considered as likely to be permanent based on the anticipated four to six year construction period during which any 'temporary' working areas would be utilised.

11.4.3 Geographical Information Systems (GIS) data showing all inland water features (including ponds, lakes, ditches, canals, streams and rivers) located within a 500m radius of the assumed extent of habitat loss were extracted from OS Mastermap data from 2010. The location of any additional water features evident on aerial photographs were then added through a manual review of areas within 500m of the boundary of the land required. Subsequently, GIS was utilised to calculate the distance of each water feature from the boundary of land required for the construction of the Proposed Scheme and the area of land falling within the extent of the land required for the construction of the Proposed Scheme falling within 100m, 250m and 500m of each water feature. This provided an indication of the maximum extent of terrestrial habitat losses that could occur in relation to each pond.

11.4.4 Each water feature identified was then examined against aerial photographs and allocated to one of the following survey categories:

- no survey;
- Habitat Suitability Index (HSI)/walkover only;
- HSI + presence/absence; and
- HSI + population size class assessment.

11.4.5 The approach taken to scoping sought to ensure that survey effort is proportionate to the predicted level of impact as a consequence of the Proposed Scheme.

11.4.6 The 'HSI/Walkover survey only' category should in general only be used as a survey prescription for those features where habitat is considered likely to have marginal potential to support great crested newt (e.g. canals, ditches), but field data are required to confirm this assessment.

11.4.7 For ponds located within the land required for the construction of the Proposed Scheme or within a 250m buffer of the boundary of the land required the basis for selecting water bodies requiring survey was in line with current Natural England guidance provided within Survey Data (1) tab of spreadsheet WML_A14_3 Version April 2013 (Natural England, 2013). However, for completeness all surveys incorporated a Habitat Suitability Index (HSI) survey (see Table 3 ) where this methodology was applicable to the water body in question.

Table 3: Survey guidance for ponds within the land required for the construction of the Proposed Scheme or within 250m of the boundary of the land required

| Scenario | Presence/ Absence | Population Size Class Assessment[26] | HSI |
|---|---|---|---|
| Pond lost or damaged as a consequence of development | ✓ | ✓ | ✓ |
| Pond not lost or damaged but within a 50m radius of the land required for the construction of the Proposed Scheme (land required) and terrestrial habitat lost | ✓ | ✓ | ✓ |
| Pond not lost or damaged but within 50-100m radius of land required and terrestrial habitat losses of ≤0.2ha | ✓ | | ✓ |
| Pond not lost or damaged but within 50-100m radius of land required and terrestrial habitat loss of >0.2ha of terrestrial habitat | ✓ | ✓ | ✓ |
| Pond not lost or damaged but within 100-250m radius of land required and terrestrial habitat loss of ≤ 0.5ha | ✓ | | ✓ |
| Pond not lost or damaged but within 100-250m radius of land required and losses of >0.5ha | ✓ | ✓ | ✓ |

Source: Based on survey guidance table provided within Survey Data (1) tab of spreadsheet WML_A14_2 Version March 2011 (Natural England, 2011) available at http://www.naturalengland.org.uk/Images/wmla14-2_tcm6-4103.xls accessed 2 March 2012.

11.4.8 For the vast majority of the alignment the route passes through arable and pasture fields that represent sub-optimal habitat for great crested newt. In general therefore it is considered that newt habitat losses associated with ponds more than 250m from the land required for the construction of the Proposed Scheme are unlikely to be significant.

11.4.9 For the purposes of the initial scoping exercise, survey of those water bodies occurring more than 250m from the boundary of the land required for the construction of the Proposed Scheme has only been proposed where:

- the terrestrial habitat around those ponds appeared to be of poor value for great crested newts, and areas of more suitable terrestrial habitat was present within the Proposed Scheme; or
- the Proposed Scheme was considered to have the potential to fragment connectivity between ponds, such that there was a potential risk of fragmentation of metapopulations[27] through loss of terrestrial habitat; or
- a pond was considered to be part of a cluster of linked ponds, and so may form part of the habitat used by a great crested newt metapopulation.

11.4.10 Appendix A details the framework utilised for determining the scope of great crested newt survey for those water features located more than 250m from the boundary of the land required for the construction of the Proposed Scheme. Table 4 details the criteria used to define potential value of terrestrial habitat located more than 250m from the pond, and the scale of barriers to movement relevant to each category.

[26] Survey will only progress to Population Size Class Assessment if presence of great crested newt is identified during presence/absence survey.
[27] A metapopulation is a group of spatially separated populations of the same species which interact at some level.

Table 4: Defining potential value of terrestrial habitats located more than 250m from pond

| **Potential value of distant terrestrial habitats within the vicinity of the land required for the construction of the Proposed Scheme** | **Relationship to other suitable habitat** |
|---|---|
| Low/Negligible | Habitats within land required for the construction of the Proposed Scheme of low or negligible suitability for great crested newt foraging and shelter (e.g. bare ground, improved grassland, arable fields, hard standing or buildings);<br><br>and/or<br><br>There is poor or no connectivity of suitable habitat with the land required (e.g. presence of a major barrier to movement such as an A road or motorway, or an extensive area of hard-standing and buildings);<br><br>and/or<br><br>Where unaffected areas of immediate and intermediate terrestrial habitat offering good connectivity with the water body and good opportunities for foraging and shelter (e.g. rough grassland, scrub, woodland, brown field habitats) are widely available closer to the pond in question such that it is considered unlikely newts would utilise distant habitat in anything other than very low numbers. |
| Medium | Where areas of immediate and intermediate terrestrial habitat offering at least some connectivity and good opportunities for foraging and shelter (e.g. rough grassland, scrub, woodland, brown field habitats) are available but are sufficiently limited in area (or patchy in distribution) that it is considered possible newts may also utilise distant habitat in low to medium numbers;<br><br>or<br><br>Where habitats within the land required and unaffected immediate or intermediate terrestrial habitat associated with the pond in question contain limited features suitable great crested newt foraging and shelter (e.g. bare ground, improved grassland, arable fields, hard standing or buildings). |
| High | Habitats within land required considered to offer good connectivity of habitat and in general better opportunities for foraging and shelter (e.g. rough grassland, scrub, woodland, brown field habitats) than those located closer to the pond in question. It is therefore considered likely these habitats would be utilised for foraging/shelter;<br><br>or<br><br>Availability of immediate and intermediate habitat suitable for foraging and shelter is considered sufficiently limited that alone it would not be sufficient to support any population associated with the pond in question. |

11.4.11 In all cases the outputs of the flowchart provided as Appendix A were reviewed by an ecological consultant alongside aerial photography and OS mapping, and taken into consideration alongside a review of the spatial layout of suitable habitat (and the potential for fragmentation effects) and the presence of barriers to dispersal.

11.4.12 Table 5 details the basis for gauging the scale of likely impact of barriers to movement. However, in all cases a final judgement on the importance of the barrier was taken in light of the wider geographical context and its distance from the breeding pond. For example, the presence of a B road in close proximity to a breeding pond would be unlikely to represent an absolute barrier to movement. However, it may be more significant when also located further from the breeding pond, or when habitat located on the far side of the barrier is of low or negligible value to newts.

11.4.13 Following consideration of all the above each water body within the confines of the scoping was allocated to one of the survey prescription categories identified in paragraph 11.4.4.

Table 5: Guide to scale of potential barriers to amphibian movement

| Scale of barrier to movement | Examples |
|---|---|
| Major | Motorway, dual carriageway, A rRoad, river or extensive areas of hard standing or intervening buildings (e.g. housing or industrial estate) |
| Moderate | B Road, major railway, major stream, moderate expanses of hard standing (e.g. small complexes of buildings or large car park) |
| Minor | Local road/track, minor railway, canal, minor stream or single buildings and small areas of hard standing |

11.4.14 As for those water bodies within 250m the 'HSI/Walkover survey only' category was in general only used for those features where habitat is considered likely to have marginal potential to support great crested newt (e.g. canals, ditches), but field data are required to confirm this assessment.

### Ongoing field scoping and survey

11.4.15 Outcomes of the desk based scoping exercise should be used as the basis for requesting land owner access, and survey planning. Where necessary when access is obtained the survey prescription should be reviewed. Where deviations are made a full justification should be documented.

11.4.16 Any additional water bodies identified during the course of other surveys (e.g. those identified during Phase 1 habitat survey) were given an appropriate survey allocation following an HSI/walkover survey.

11.4.17 For all water bodies where 'HSI/Walkover survey' is prescribed an HSI assessment should be conducted (where appropriate) and a record made of the outcome of the survey (i.e. level of further survey prescribed or the rationale for scoping out). Where an HSI score of less than 0.5 (i.e. rating of 'poor') is achieved, and inspection of the water body by an ecologist suggests that it is unlikely to support great crested newt, the water body may be scoped out.

11.4.18 In addition throughout the course of field surveys consideration should be given to the need to increase the level of survey effort at those ponds initially only subject to presence/absence survey, due to changes in design or potential impact. Additional survey effort should be specified where this is considered necessary to provide a robust baseline for the assessment of potential significant effects.

## 11.5 Survey methods

### Presence/absence survey

11.5.1 During each survey visit until presence is confirmed at least three survey methods are to be employed. In the first instance this should consist of the following:

- torchlight survey;
- bottle trapping; and
- egg searching.

11.5.2 In some cases conditions at the pond or physical constraints to access (e.g. presence of dense scrub adjoining part of the ponds, or unstable margins) may mean that it is not possible or appropriate to utilise these preferred methods. In these cases the

unsuitable method should be substituted for an alternative method according to the following:

- netting should be utilised as the first alternative survey methodology; and
- refuge search should only be utilised where two or more other survey methodologies are inappropriate.

11.5.3 In each case where a deviation from the standard three survey methodologies is required, the survey notes are to include a justification for this deviation.

## Population size class assessment

11.5.4 All survey visits are to utilise torchlight survey, bottle trapping and egg search unless these methods are not feasible. As soon as presence of great crested newt eggs is confirmed, egg searching will cease.

11.5.5 Where one of the three survey methods identified in paragraph 11.5.1 is considered inappropriate the following guidance should be followed:

- if the peak recorded great crested newt count by a single survey method is fewer than 10 individuals, netting or, if this is not possible, refuge search should be used; but
- if a peak count of 10 or more great crested newt has previously been recorded using a single survey method, then use of alternative survey methodologies is not required.

## Terrestrial habitat survey

11.5.6 In a small number of locations where access to a pond is not possible, it may be necessary to deviate from the standard methodology for presence/absence survey and conduct terrestrial habitat survey utilising pitfall traps on adjacent land to determine presence/absence.

11.5.7 In all such cases recommendations for terrestrial habitat survey of this type should be brought to the attention of Natural England immediately, along with recommendations for the proposed terrestrial habitat survey. The default position will be terrestrial presence/absence survey in accordance with Great Crested Newt Mitigation Guidelines (English Nature, 2001).

## Late season amphibian survey

11.5.8 Where pond based presence/absence surveys are not completed during the available mid-March to mid-June survey window, at locations within or in close to the land required for the construction of the Proposed Scheme, late season amphibian survey (i.e. survey between mid-June and end of September) should be utilised where possible in order to gain an early indication of where great crested newts are present.

11.5.9 The methodology for late season amphibian survey is provided in Appendix B of this document.

11.5.10 Late season survey will only be used to confirm presence, and will not be utilised to assume absence. All ponds subject to survey of this type during late 2012 will also be subject to full survey during the period mid-March to mid-June 2013.

## 11.6 Field survey techniques

11.6.1 Field survey techniques to be utilised are based on those provided within Great Crested Newt Mitigation Guidelines (English Nature, 2001), with additional guidance provided in order to ensure consistency.

### Torchlight survey

- all torchlight survey should utilise torches of at least 1 million candle power;
- torchlight survey should not commence until at least 1 hour after published local sunset time;
- where areas of the pond are omitted (due to restricted accessibility or health and safety constraints) an estimate of the percentage of the pond margin omitted and a justification for this is to be included within the notes section of the recording form;
- during each survey visit the turbidity and vegetation cover of the water body is be scored against the five point scales advocated by Natural England;
- where a turbidity or vegetation cover score of 4 is allocated, torchlight survey is still to be conducted but due to potential unreliability it should be complemented by use of an additional survey method (e.g. netting); and
- where a turbidity or vegetation cover score of 5 is allocated, torchlight survey is to be replaced by an appropriate alternative method (e.g. netting).

### Egg searching

- egg searching is to be halted when searches confirm presence of great crested newt eggs, and from this point forward not be repeated during subsequent visits; and
- the use of 'egg strips' should only be considered where conventional egg searching is not appropriate and other constraints mean it is not possible to complete survey using three of the remaining available conventional survey methods (i.e. bottle trapping, torching, netting, refuge survey).

### Bottle trapping

- all bottle traps used are to be created from clear plastic 2 litre round bottles and be secured utilising a bamboo cane or similar;
- where utilised, bottle traps are be positioned at a frequency of one every 2m in areas of suitable habitat; for large water bodies where this is not practical, areas of trapping should focus on targeted survey of sections of the margin which support the most suitable habitat;
- where areas of the pond are omitted (due to restricted accessibility or health and safety constraints), an estimate of the percentage of the pond margin omitted and a justification for this is to be included within the notes section of the recording form;

- bottle trapping is only to be utilised on nights where overnight temperature is forecast to be 5°C or above;
- all bottle traps are to be set to include an air bubble; and
- bottle trapping should seek to avoid capture of water shrews; where they are known to occur or are identified during survey, bottle trapping should be replaced by an alternative survey method.

### Netting

- all netting is to be conducted at night; as netting causes widespread disturbance of the pond, where used in combination with torchlight survey it should only be conducted following completion of torching; and
- nets utilised should have a mesh size of 2-4mm.

### Refuge search

- where utilised as a pond survey methodology refuge search will be conducted during each of the proposed four/six survey visits;
- survey should incorporate checks of both natural refuges (such as logs, bark, rocks, debris) and where possible artificial refugia placed around the margins of the pond; and
- where it is clear that refuge search will be utilised as a survey methodology for subsequent visits, carpet tiles should be placed face down every 2m around the pond margin and the refuges allowed to settle 7 days before the next survey visit.

### Habitat Suitability Index

11.6.2 A Habitat Suitability Index (HSI) is to be calculated for all ponds within the land required for the construction of the Proposed Scheme, or within a 250m buffer of its boundary that are identified as requiring presence/absence or population size class assessment survey, according to the criteria set out in Table 3, as well as any other ponds that are subject to full survey.

11.6.3 All surveyors are to use the simplified HSI methodology described in ARG UK Advice Note 5: Great Crested Newt Habitat Suitability Index (2010)[28].

11.6.4 Where possible HSI scores for the ten component indices are to be calculated from data collected during a survey visit during the period mid-April to mid-May. During subsequent surveys notes are to be made of factors/events that may have resulted in a significant change to the HSI score previously calculated.

11.6.5 Where a suitability index cannot be allotted for any of the ten component indices then a comment should be recorded to explain this. In addition a comment should be recorded where the surveyor considers that the atypical nature of a water body may result in an unreliable HSI score.

[28] Amphibian and Reptile Groups of the United Kingdom (2010). *ARG UK Advice Note 5: Great Crested Newt Habitat Sustainability Index.* Amphibian and Reptile Groups of the United Kingdom.

### Dealing with non-native amphibians

11.6.6 If non-native amphibian species occurring on Schedule 9 Part 1 of the Wildlife and Countryside Act (1981 as amended) are captured during the course of the survey (e.g. within bottle traps or nets) they will not be released back into the wild. For non-natives which do not appear on Schedule 9 their presence should be noted on recording forms and individuals released.

## 11.7 Survey programme and effort

### Presence/absence survey

11.7.1 Presence/absence surveys are to comprise four visits in suitable weather conditions as defined in Great Crested Newt Mitigation Guidelines (English Nature, 2001).

11.7.2 Visits are to be conducted during the period mid-March to mid-June, with at least two visits during the period mid-April to mid-May.

11.7.3 Visits should ideally be well spaced (no more than one per week and no more than four weeks apart). Survey visits to the same pond on consecutive nights should be avoided. In the event that the required survey effort is not completed then the use of non-standard methodologies which may provide early warning to the presence of great crested newts will be considered (see Appendix B). These methods cannot be utilised to determine absence, and in all cases water bodies subject to these methods during late 2012 will be subject to full survey utilising standard methods during the period mid-March to mid-June 2013.

11.7.4 Where presence/absence survey is not completed during 2012 then the survey will be repeated in full during the 2013 season (e.g. if only two visits completed during 2012 then a further four visits should be conducted during 2013 season).

### Population size class assessment

11.7.5 Population size class assessment is to comprise six pond visits in suitable weather conditions (English Nature, 2001). These are to be conducted between mid-March to mid-June, with at least three of these visits during the period mid-April to mid-May.

11.7.6 Visits should ideally be well spaced (no more than one per week and no more than four weeks apart). Survey visits to the same pond on consecutive nights should be avoided.

11.7.7 In the event that the required survey effort is not completed during 2012 then the survey should be repeated in full during the 2013 season (e.g. if only two visits completed during 2012 then a full six visits should be conducted during 2013 season).

### Habitat Suitability Index

11.7.8 HSI scores for the ten component indices are to be calculated from data collected during a survey visit. Where constraints allow this should be conducted during the period mid-April to mid-May.

## 11.8 References


Amphibian and Reptile Groups of the United Kingdom (2010). ARG UK Advice Note 5: Great Crested Newt Habitat Suitability Index. Amphibian and Reptile Groups of the United Kingdom

English Nature (2001). Great Crested Newt Mitigation Guidelines. English Nature, Peterborough.

Gent T and Gibson S (2003). Herpetofauna Workers Manual. JNCC, Peterborough.

Natural England (2011) Great crested newt method statement Template WML_A14_2 Version March 2011 available at http://www.naturalengland.org.uk/Images/wmla14-2_tcm6-4103.xls accessed 02/03/12.

Natural England (2013) Great crested newt method statement Template WML-A14-3 Version April 2013 downloaded at http://www.naturalengland.org.uk/Images/wmla14-2_tcm6-4103.xls on 02/10/13.

# 12 Reptiles

## 12.1 Introduction and guidelines

12.1.1 It is anticipated that a range of habitats within the land required for the construction of the Proposed Scheme will represent suitable habitat to support widespread reptile species, namely adder (*Vipera berus*), slow worm (*Anguis fragilis*), grass snake (*Natrix natrix*) and common lizard (*Zootoca vivipara*). The route is located outside of areas known to support sand lizard (*Lacerta agilis*) and smooth snake (*Coronella austriaca*). As a consequence it is unlikely that survey for these species will be required.

12.1.2 Reptile survey in support of the scheme will be conducted according to a bespoke methodology which draws heavily upon guidance provided in documents listed in Section 12.7.

## 12.2 Qualifications and experience

12.2.1 All surveyors involved in screening and scoping for reptiles should be experienced in the following:

- field identification of all widespread reptile species and field signs (e.g. sloughs, burrows and eggs);
- assessing the potential suitability of on-site habitats for widespread reptile species;
- determining appropriate spatial scope for survey; and
- identifying appropriate survey techniques to achieve a robust survey in a variety of habitat types.

## 12.3 Licensing requirements

12.3.1 Survey is only anticipated to involve widespread reptile species; as such no survey licence is required.

## 12.4 Screening for survey and defining the survey area

12.4.1 Analysis of aerial photographs was initially undertaken to identify and map the extent of key habitat areas within close proximity to the route of the Proposed Scheme that were considered potentially suitable to support reptiles. Consultants should review preliminary work, alongside desk study data and the results of Phase 1 habitat survey to identify any additional areas of potentially suitable habitat within the land required for the construction of the Proposed Scheme and a surrounding 100m buffer.

12.4.2 For all such areas identified as containing habitat potentially suitable to support reptiles, a walkover survey should be conducted by an appropriately experienced ecologist in order to appraise the suitability of the habitats present on the ground. The habitat assessment should be based on consideration of the following characters:

- location in relation to species range;
- vegetation structure;

- insolation (sun exposure);
- aspect;
- topography;
- surface geology;
- connectivity to nearby good quality habitat;
- prey abundance;
- refuge opportunity;
- hibernation habitat potential;
- disturbance; and
- egg-laying site potential (grass snake only).

12.4.3 For each habitat area the output of the habitat assessment should be a grading of each habitat area as having either 'poor', 'good' or 'exceptional' potential to support widespread reptiles, based on reasoned consideration of the above factors. Examples are provided in Table 6.

Table 6: Grading of reptile habitat suitability

| Habitat Grading | Definition |
|---|---|
| Poor | Habitat which is unfavourable for reptiles based on the majority of the habitat assessment characters listed above, or is limited in size and highly isolated from other areas of suitable habitat. |
| Good | Habitat which is favourable or sub-optimal for many of the habitat assessment characters listed above; or is sub-optimal for some of the characters and has good connectivity with areas of more suitable habitat. |
| Exceptional | Habitat which is favourable for reptiles based on the majority of habitat assessment characters listed above. |

12.4.4 The grading of each habitat area should note for which species the habitat area is potentially suitable.

12.4.5 Where habitat areas identified for walkover survey are found to contain distinct areas of habitat that do not contribute to the overall value of the habitat parcel for reptiles, the habitat area should be divided. A unique reference code and habitat grading should then be allocated to each habitat area. For example an area of improved grassland within a block of rough grassland and scrub would be given its own unique reference code and graded as being of 'poor' value based principally on the habitat structure.

12.4.6 All habitat areas falling within the identified survey extent identified as having 'good' or 'exceptional' potential to support reptiles and no significant barriers preventing dispersal to land require for the construction of the Proposed Scheme will be selected for further presence/absence survey utilising artificial refugia.

## 12.5 Survey method

12.5.1 Where health and safety and access constraints allow, all habitat areas identified as having 'good' or 'exceptional' potential to support reptiles using the table above will be subject to survey utilising artificial refugia.

12.5.2 In each habitat area a combination of corrugated iron and roofing felt refugia all measuring a minimum of 0.5m x 0.5m are to be placed out in areas identified as suitable habitat. At sites where the habitat assessment has identified potential for grass snake to occur surveyors should deploy an appropriate number (based on extent of suitable habitat) of larger refugia, to increase the likelihood of detecting this species.

12.5.3 In non-linear habitats refugia should be placed at a density of at least 100/ha or a minimum 30 mats in very small sites. In linear habitats of less than 10m in width (e.g. hedgerows, road verges etc.) refugia should be placed at a frequency of at least one every 10m of suitable habitat.

12.5.4 The default should be a 50 : 50 ratio of corrugated steel/iron to roofing felt. Where varying from this standard a justification should be provided, based on the habitat type and target species concerned.

12.5.5 All refugia should be number marked using spray paint and their location accurately recorded to an accuracy of <5m where terrain/vegetation allows, to allow later translation to GIS. It is recommended that locations are recorded using a GPS device.

12.5.6 Once placed out artificial refugia will be left to settle for 14 days prior to conducting the first check.

12.5.7 Each site containing refugia will then be checked for reptiles on the required number of occasions (see Section 12.6). Binoculars should be used to check for reptiles between refugia, as well as careful checks by lifting each refugium.

12.5.8 Each refugia check should be conducted during the following conditions:

- Time: conducted between 07:00 and 18:00;
- Air temperature: 10°c - 20°C;
- Wind: Still to moderate (equivalent to Beaufort 4; 13 - 17mph); and
- Rain: No or light rain only at time of survey. Surveys between periods of heavy rain (when all other conditions are suitable) are also acceptable.

12.5.9 During each check the surveyor should record details of all reptiles encountered during the survey, including refugia number, species, number, life stage (adult, sub-adult, juvenile) and when possible, sex.

12.5.10 If non-native species listed on Schedule 9 are found during the survey then details will be recorded as described in paragraph 12.5.9. As no handling of reptiles is anticipated as part of the survey all non-native species will be left in-situ. Where necessary provisions for their removal will be included within the Environmental Statement and any subsequent mitigation statements.

12.5.11 All records of reptiles should be provided with GPS-derived grid coordinates. Where topography and vegetation structure may have reduced the accuracy of records below an accuracy of <5m, this information should be noted.

12.5.12 Where areas of suitable reptile habitat are located within the boundaries of the existing operational rail or road estate it is anticipated that there may be both health and safety and access issues that will prevent refugia survey of all those areas of

habitat identified as potentially suitable for reptiles. In these cases the consultants undertaking surveys will be expected to liaise with the overseeing consultant in order to determine a suitable survey approach for these areas. It is anticipated that this will involve consideration of the following potential approaches:

- sampling of areas of similar adjacent habitat;
- visual search only; and
- risk assessment based on habitat suitability.

## 12.6 Survey programme and effort

### Presence/absence survey

12.6.1 At all locations selected for refugia survey initially, seven visits (during suitable weather conditions) should be conducted to determine presence/absence.

12.6.2 Each visit should adhere to the weather requirements detailed in paragraph 12.5.8 and should be conducted during the period April to September.

12.6.3 Where access allows surveys should be programmed to maximise the number of visits conducted during April, May, June and September, when weather conditions are likely to be more favourable for survey. However, visits during July and August are not precluded assuming they are conducted according to the weather requirements detailed in 12.5.8.

12.6.4 There should be at least 30 days between the first and last survey visits and there must be a minimum of two days between each visit.

12.6.5 A robust survey to determine likely absence should include at least four visits conducted during the 'optimum' survey months of April, May, June or September. As a consequence at sites where surveys commence during July or August if no reptiles are found during the first three visits then the remainder of visits should be delayed and conducted during September.

### Estimating population size class

12.6.6 Where presence/absence survey confirms presence of one or more reptile species and all survey visits have been conducted during the 'optimum' survey months of April, May, June or September (under suitable conditions) then (unless the surveyor considers it necessary) no further visits will be required.

12.6.7 In order to give a robust estimate of population size where any survey visits have been conducted during the sub-optimal months of July or August, additional visits will be required until at least seven visits (under suitable conditions) have been conducted during optimum months.

12.6.8 Where initial survey results suggest that a site has the potential to support a 'high' reptile population then the consultants undertaking the survey should consider the requirement for further visits to provide a robust population size class estimate.

12.6.9 Population size class should be assessed utilising the peak adult count for each species across all visits. These figures should be divided by the survey area in ha to give an indication of density identified within the survey, then compared with the criteria

outlined in Evaluating local mitigation/translocation programmes: Maintaining best practice and lawful standards (HGBI, 1998)[29]. A summary is provided in Table 7.

Table 7: Estimating population size

| Species | Population size class | Density recorded |
|---|---|---|
| Slow worm | High | more than 100/ha |
| | Medium | 50-100/ha |
| | Low | less than 50/ha |
| Common lizard | High | more than 80/ha |
| | Medium | 20-80/ha |
| | Low | less than 20/ha |
| Grass snake | High | more than 4/ha |
| | Medium | 2-4/ha |
| | Low | less than 2/ha |
| Adder | High | more than 4/ha |
| | Medium | 2-4/ha |
| | Low | less than 2/ha |

Source: Derived from HGBI (1998) Evaluating local mitigation/translocation programmes: Maintaining best practice and lawful standards.

### Surveys split between seasons

12.6.10 Where surveys are commenced during 2012 but not completed, these may be 'topped-up' with visits conducted during 2013, assuming that the resulting data set meets the relevant conditions for timing, survey conditions and number of visits as set out above.

## 12.7 References


Froglife (1999). Reptile survey; an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife Advice Sheet 10. Froglife, Halesworth.

Gent T and Gibson S eds (2003). Herpetofauna Workers Manual. JNCC, Peterborough.

Herpetofauna Groups of Great Britain and Ireland (1998). Evaluating local mitigation/translocation programmes: Maintaining best practice and lawful standards. HGBI, Halesworth.

Natural England (2011). Natural England Technical Information Note TIN102: Reptile Mitigation Guidelines. Natural England, Peterborough. (Note this guidance was published and subsequently withdrawn in September 2011).


[29] Herpetofauna Groups of Great Britain and Ireland *(1998). Evaluating local mitigation/translocation programmes: Maintaining best practice and lawful standards*. HGBI, Halesworth.

# 13 Breeding birds

## 13.1 Introduction and guidelines

13.1.1 The purpose of breeding bird surveys within the context of environmental impact assessment (EIA) is to establish baseline data on the species, numbers and distribution of birds within and adjacent to the land required for the construction of the Proposed Scheme so that potential significant impacts of the scheme can be assessed. Particular attention is required where species listed on Schedule 1 of the Wildlife and Countryside Act (1981 as amended) are suspected or found.

13.1.2 A review of methods available for survey of breeding birds can be found in Bibby, et al (2000)[30].The principal method employed for the EIA of the Proposed Scheme will be a variation of the Common Bird Census (CBC) methodology (Marchant, 1983[31]) involving five visits during the 2013 breeding season. Where initial survey visits were conducted during 2012 in order to provide an early understanding of bird use of the route of the Proposed Scheme, the full five visits should be repeated during 2013 in order to provide reliable data for use in territory analysis. Where appropriate, further specific surveys will be undertaken for protected and/or notable species (e.g. barn owl, hobby, nightjar, black redstart).

## 13.2 Qualifications and experience

13.2.1 Surveyors should be able: to identify birds confidently from visual observation as well as songs/calls; to identify specific bird habitats that could support nesting birds listed on Schedule 1; to identify bird behaviours, including territorial displays and nesting behaviour; to use with confidence common survey techniques including territory mapping, point counts and transect surveys; and to interpret bird survey data.

## 13.3 Licensing requirements

13.3.1 A Natural England licence is required where surveys are likely to disturb Schedule 1 species, including nesting barn owls. In the vast majority of cases survey according to the Common Bird Census (CBC) (Marchant, 1983) methodology proposed is considered unlikely to constitute a legal offence. Where it is necessary, survey routes should be sensitively modified in order to limit disturbance. However, ultimately individual surveyors should for all proposed surveys judge where disturbance is likely to occur and provide appropriately licensed survey staff where necessary.

## 13.4 Screening for survey and defining the survey area

13.4.1 The extent of the CBC style survey (as described in Section 13.5) should be defined by the outcome of Stage 1 and Stage 2 below.

### Stage 1 – Sites of known importance for breeding birds

13.4.2 Surveyors should initially undertake a review of existing information (designation details, desk study records of notable species, county bird reports) to identify sites of known importance for birds where there is considered to be the potential for adverse effects as a consequence of the Proposed Scheme. The necessary extent of this search

[30] Bibby, C.J., Burgess, N.D., Hill, D.A., and Mustoe, S.H. (2000). *Bird Census Techniques,* 2nd ed. Academic Press, London.
[31] Marchant, J.H. (1983). *Common Bird Census Instructions.* BTO, Tring.

area will vary based on the nature of the sites present and the proposed engineering design of the scheme. However, as a minimum this search should encompass a 250m buffer either side of the land required for the construction of the Proposed Scheme.

13.4.3 Any such sites where there is considered to be the potential for adverse effects as a consequence of the Proposed Scheme will be included within the scope of the CBC style survey.

### Stage 2 – Other areas identified as being of potential importance for breeding birds

13.4.4 Surveyors should undertake a review of the following information sources to identify locations of potential importance for breeding birds (i.e. areas which are considered to have potential to support notable species such as those listed on Annex 1 of the Birds Directive, Schedule 1 of the Wildlife and Countryside Act, or red or amber listed species on the Birds of Conservation Concern list; or which may support notable assemblages of common birds) within the land required for the construction of the Proposed Scheme and a 250m buffer either side of it that are potentially subject to adverse effects:

- aerial photography and Ordnance Survey mapping;
- Phase 1 habitat survey results;
- feedback from wintering bird surveys conducted during 2012/2013; and
- discussions with local consultees.

13.4.5 Any such sites will be included in the scope of the CBC style survey.

### Stage 3 – Sampling of other habitats (i.e. those not covered by Stage 1 and Stage 2)

13.4.6 Following completion of Stages 1 and 2 a survey strategy should be established to ensure that survey includes a sample of all other habitats within the land required for the construction of the Proposed Scheme and a 250m buffer either side of it. This is intended to provide an indication of the birds using these habitats and should give preference to areas within the land required for the construction of the Proposed Scheme. As a guide the sampling of other habitats that are not identified in Stage 1 and Stage 2 should seek to achieve a minimum of 20% coverage within each Community Forum Area (CFA). It should be noted that this is in addition to the coverage required to satisfy Stage 1 and Stage 2. Coverage may be increased where appropriate.

### Stage 4 – Further detailed survey for protected and/or notable species

13.4.7 In addition to the CBC type surveys described above consultants undertaking survey should consider the requirement for additional survey work in order to assess potential impact on species listed on Schedule 1 of the Wildlife and Countryside Act (1981 as amended)[32] and Annex 1 of the Birds Directive[33].

[32] *Wildlife and Countryside Act* (1981) Chapter 69. Her Majesty's Stationery Office.
[33] *Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds* (2009). Official Journey of the European Union.

13.4.8 Consultants should undertake a desk based exercise to identify the likely extent of Schedule 1/Annex 1 species surveys required within the areas for which they are responsible. The results of the desk based exercise should initially consider records from within 5km and a desk based appraisal of suitable habitat availability within 1.5km to determine the scope of detailed field surveys required.

## 13.5 Survey methods

### Common Bird Census style survey

13.5.1 Survey will comprise five visits between mid-March and the end of June with at least ten days between each visit. Where access allows these should be spread as evenly as possible throughout the survey season. Unless a site specific deviation is agreed then where access allows the full five survey visits should be conducted during 2013, even if some survey visits were achieved during 2012.

13.5.2 Survey visits will be undertaken on dry days with no more than moderate wind. Survey during dawn mist is acceptable but survey during dense fog should be avoided. Site visits should commence no later than one hour after sunrise. In order to avoid confusion and reduce survey bias in areas with high densities of birds the survey should be commenced towards the end of this window. In addition the starting position should be varied between visits in order to reduce survey bias. In all cases survey should ideally be completed by 11am (12 noon at the latest).

13.5.3 Due to the scale of the survey proposed it will not be practical to approach all areas within 50m. As a consequence in large expanses of open grassland or arable fields the boundaries will be walked and all birds within the field recorded. In other habitat where access and views allow, efforts will be made to record all bird activity within 50m of the survey route. Where no access is available, Public Rights of Way (PRoW) and local roads (where it is deemed safe to do so) will be utilised.

13.5.4 In all cases all birds seen or heard will be identified and recorded on a suitable scale map of the site to allow the information to be clearly recorded using standard British Trust for Ornithology (BTO) species and activity codes.

13.5.5 Large wetland areas can be covered by the CBC style survey as proposed above, but will be a combination of recording the activity of individual birds and counts of birds on the water from the lake edge.

### Species specific surveys

13.5.6 Species specific surveys should be conducted as appropriate, and where considered to be required (based on the results of scoping and results from Phase 1 habitat survey and initial breeding bird surveys) should include both the land required for the construction of the Proposed Scheme and a surrounding 250m buffer . As a minimum this should include consideration of potential nesting locations for Schedule 1 species such as barn owl, red kite, hobby and peregrine.

13.5.7 Survey for Schedule 1 species should follow established best practice survey methodologies as follows:

- barn owl – Shawyer (2011);[34] and
- red kite/hobby/peregrine/black redstart/nightjar/kingfisher – Gilbert et al (1998)[35]

13.5.8 Where crepuscular or nocturnal species such as nightjar are suspected then evening survey visits (in addition to those forming part of the CBC survey) should be undertaken. At each appropriate site at least two evening visits including the hour after sunset should be conducted.

## 13.6 References

Bibby, C.J., Burgess, N.D., Hill, D.A., and Mustoe, S.H. (2000). Bird Census Techniques, 2nd ed. Academic Press, London.

Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds (2009). Official Journey of the European Union.

Gilbert, G., Gibbons, D.W., and Evans J (1998). Bird Monitoring Methods. RSPB, Sandy.

Marchant, J.H. (1983). Common Birds Census instructions. BTO, Tring.

Shawyer, C. R. (2011). Barn Owl Tyto alba: Survey Methodology and Techniques for use in Ecological Assessment. Developing Best Practice in Survey and Reporting. IEEM, Winchester.

Wildlife and Countryside Act (1981) Chapter 69. Her Majesty's Stationery Office.

[34] Shawyer, C.R. (2011). *Barn Owl Tyto alba: Survey Methodology and Techniques for use in Ecological Assessment. Developing Best Practice in Survey and Reporting*. IEEM, Winchester.
[35] Gilbert, G., Gibbons, D.W. and Evens, J. (1998). *Bird Monitoring Methods*. RSPB, Sandy.

# 14 Wintering and passage birds

## 14.1 Introduction and guidelines

14.1.1 Survey methods are to be appropriate for lowland rural habitats including farmland and wetlands. These should be based on the methods in Gilbert et al (1998)[36] and the Wetland Bird Survey (WeBs) methodology (Pollit et al., 2003)[37].

## 14.2 Qualifications and experience

14.2.1 Surveyors are to be experienced in bird survey techniques and identification.

## 14.3 Licensing requirements

14.3.1 There are no licensing requirements for wintering bird survey.

## 14.4 Screening for survey and defining the survey area

14.4.1 Consultants undertaking surveys should aim to screen and consider discounting areas from survey where it is likely that the habitats support only low numbers of common birds whose conservation status would not be significantly affected by the Proposed Scheme. It is anticipated that wintering bird survey will focus on survey of water bodies with sampling of woodland and farmland habitats.

14.4.2 The decision on which areas to include within the scope of wintering bird surveys should be based on:

- records of notable species from desk study (bird data from the local Biological Records Centre and the County Bird Report);
- the presence of good quality habitat, as identified during the Phase 1 habitat survey; and
- discussions with local consultees.

14.4.3 All areas identified based on the above criteria should be included within the wintering bird survey. In addition within each 10km section of the route the survey should include a representative sample of approximately 20% of all farmland and woodland habitats located within the land required for the construction of the Proposed Scheme and within a 100m buffer of the land required. Where access is freely available the areas selected for survey should cover a range of different habitat types and focus on locations within or directly adjacent to the land required.

14.4.4 Consultants undertaking surveys should use professional judgement to determine those locations where a more intensive survey sample (i.e. above the level defined in paragraph 13.4.2) is required.

[36] Gilbert, G., Gibbons, D.W. and Evans, J. (1998), *Bird Monitoring Methods: A Manual of Techniques for Key UK Species. Royal Society for the Protection of Birds*, The Lodge, Sandy, Beds.
[37] Pollit, M.S., Hall, C., Holloway, S.J., Hearn, R.D., Marshall, P.E., Robinson, J.A., Musgrove, A., Robinson, J., and Cranswick, P.A. (2003), *The Wetland Bird Survey 2000-2001: Wildfowl & Wader Counts*. Slimbridge.

## 14.5 Survey method

14.5.1 Wintering and passage bird survey will focus on wetland sites, and will utilise the Wetland Bird Survey (WeBS) methodology (Pollit et al, 2003).

14.5.2 In each case the survey is to be undertaken at all wetland sites within the land required for the construction of the Proposed Scheme and within the 100m buffer of the land required. Survey will be conducted once per month through the period October to February, with additional visits during September and/or March where necessary to detect anticipated target species.

14.5.3 Outside wetland areas known to be of importance for wintering or passage birds, surveys within farmland, woodland and any other areas of suitable habitat identified by surveyors, will be based on a sampling approach. Outside wetland areas, surveys should aim to sample approximately 20% of the suitable habitat located within 100m of the land required for the construction of the Proposed Scheme for each 10km section. The length of the total survey route required to obtain this coverage will vary depending on the extent of views. Visible areas should be mapped by surveyors during the first survey visit to show the survey extent. Surveyors are to determine whether sampling density needs to increase locally to address habitat variety or complexity.

14.5.4 The route of the survey will be chosen to sample the range of suitable habitat types present. All visits are to be completed between one hour after sunrise and one hour before sunset.

14.5.5 On each of the survey visits the surveyor is to walk the survey area at a steady pace recording the location of all birds seen or heard on a plan using standard BTO species codes.

14.5.6 Vantage point survey should be conducted in wetland areas where construction of viaducts is proposed. Survey should comply with current Natural England guidance as outlined within TIN008 Assessing ornithological impacts associated with wind farm developments: surveying recommendations[38] and include at least 36hrs of survey at each vantage point location over the period September to mid-March inclusive.

## 14.6 Survey programme and effort

14.6.1 The survey programme for wintering bird surveys is described above.

## 14.7 References

Bibby, C.J., Burgess, N.D., Hill, D.A., and Mustoe, S.H. (2000). Bird Census Techniques, 2nd ed. Academic Press, London.

Gilbert G., Gibbons D.W. and Evans J. (1998). Bird Monitoring Methods: A Manual of Techniques for Key UK Species. Royal Society for the Protection of Birds, The Lodge, Sandy, Beds.

Marchant, J.H. (1983). Common Birds Census instructions. BTO, Tring.

[38] Natural England (2007). *Technical Information Note TIN008 Assessing ornithological impacts associated with wind farm developments: surveying recommendations.* First edition 15 October 2007, www.naturalengland.org.uk.

Natural England (2007). Technical Information Note TIN008 Assessing ornithological impacts associated with wind farm developments: surveying recommendations. First edition 15 October 2007, www.naturalengland.org.uk.

Pollit, M.S., Hall, C., Holloway, S.J., Hearn, R.D., Marshall, P.E., Robinson, J.A., Musgrove, A., Robinson, J. and Cranswick, P.A. (2003). The Wetland Bird Survey 2000-2001: Wildfowl and Wader Counts. Slimbridge.

# 15 Hazel dormouse

## 15.1 Introduction and guidelines

15.1.1 Survey for hazel dormouse (*Muscardinus avellanarius*) will need to consider both perceived optimal woody habitats (e.g. hazel coppice dominated woodland) and areas of fragmented or sub-optimal habitat within the vicinity of the Proposed Scheme. This will include consideration of how habitat losses associated with the scheme may affect the movement of dormice associated with retained habitat through the route corridor.

15.1.2 The proposed approach will broadly follow the nest tube survey methodology developed during the South West Dormouse Project (Chanin and Woods, 2003)[39]. It will also take into account Natural England's December 2011 interim advice note on dormouse surveys for mitigation licensing (Natural England, 2011)[40].

## 15.2 Qualifications and experience

15.2.1 All initial scoping and habitat assessment work should be conducted by persons with previous experience of the range of habitats utilised by dormouse and field signs indicating potential presence of dormouse.

15.2.2 The erection of dormouse nest tubes should be coordinated by persons experienced in nest tube survey.

## 15.3 Licensing requirements

15.3.1 Checking of nest tubes will require at least one surveyor within a survey team to hold a licence to 'take and disturb' hazel dormouse. Assistants may only be utilised where they are working in close proximity to a licence holder at all times. When working distant from each other (including in different areas of the same survey site) all other surveyors within a survey team should be named accredited agents to the licence holder each of whom has been trained and is experienced in identification and handling of dormouse.

## 15.4 Screening for survey and defining the survey area

15.4.1 Analysis of aerial photographs has been used to identify and map the extent of key areas of habitat within the route corridor that are considered potentially suitable to support hazel dormouse. Review of desk study data and the results of Phase 1 habitat survey by consultants undertaking survey work may result in additional areas. This assessment should include habitat potentially of value for nesting and foraging, and should take into account fragmented habitats and areas of potentially sub-optimal habitat that may be of importance in a wider landscape context.

15.4.2 For all areas identified as containing habitat potentially suitable to support dormouse, a walkover survey should be conducted by an appropriately experienced ecologist in order to appraise the suitability of the habitats present on the ground, and to

[39] Chanin, P. and Woods, M. (2003), *Surveying dormice using nest tubes: results and experiences from the South west Dormice projects*. English Nature Research Report No. 524. English Nature, Peterborough.
[40] Natural England (2011), *Interim Natural England Advise Note – Dormice surveys for mitigation licensing – best practice and common misconceptions*. Natural England, Peterborough.

determine the need for nest tube survey. The habitat assessment should be based on consideration of the following characters:

- availability of key food sources;
- vegetation structure (in particular the extent of arboreal linkage);
- level of shading; and
- connectivity with other areas of suitable or sub-optimal habitat.

15.4.3 Where walkover survey and habitat assessment indicate that not all of an identified habitat area requires nest tube survey, the habitat area should be subdivided and a unique reference code and assessment outcome allocated to each habitat area.

## 15.5 Survey method

### Nest tube/nest box survey

15.5.1 At each site selected for nest tube survey, tubes of standard design (i.e. made from stiff double walled black plastic measuring approximately 5cm width x 5cm height x 25cm length with a small plywood tray blocking one end and projecting 5cm from the other) are to be deployed in potentially suitable habitat (as defined by the outcome of the habitat assessment).

15.5.2 Tubes should be deployed in clusters 15-20m apart, sampling both areas of best quality habitat and associated areas that may appear less suitable according to traditional concepts of dormouse habitat quality (e.g. hedgerows linking to areas of deciduous woodland).

15.5.3 A revision to the survey methodology made in September 2012 required a minimum of five dormouse nest boxes to be deployed (at a minimum of 20m spacings) in areas of deciduous woodland survey sites to increase the potential for detecting dormouse presence in these locations. This methodology change should be applied to all surveys commenced post September 2012, and all suitable survey sites where tubes have already been deployed.

15.5.4 All tube and box locations should be mapped and OS grid references recorded by GPS to an accuracy of <5m where terrain and vegetation cover allows. Where necessary, markers such as coloured string or high visibility tape should also be deployed to aid the process of locating nest tubes and boxes during subsequent visits.

15.5.5 During each check all nest tubes and boxes should be inspected for potential signs of use by dormouse including the following:

- presence of individuals in-situ;
- characteristic nesting material;
- presence of characteristic gnawed hazel nuts; and
- presence of droppings.

15.5.6 During each check, the above information will be recorded alongside similar information that indicates use of nest tubes or boxes by other species (e.g. squirrel, field mouse etc.).

15.5.7 During each visit a record should be made of the number and location of any tubes or boxes that have been dislodged or interfered with since the previous survey visit.

15.5.8 The first survey visit should not be conducted until at least one calendar month after completion of tube or box installation in that area.

15.5.9 All records of dormouse and other species identified utilising nest tubes or boxes should be provided with GPS-derived grid coordinates accurate to <5m. Where topography and vegetation structure may have reduced the accuracy of records below this level this information should be noted.

15.5.10 Where potential dormouse droppings are found that cannot be definitively identified in the field, a small sample (considered to represent droppings from a single species) should be collected and sealed in a plastic bag marked with the following details:

- date sample collected (day/month/year);
- survey location and tube/boxnumber;
- GPS coordinates of tube/box concerned;
- suspected species; and
- surveyor name.

15.5.11 Dropping samples should be stored in a cool, dry place and submitted as soon as possible for DNA analysis to determine if hazel dormouse is present.

### Nut searches

15.5.12 Nut searches will only be utilised to confirm presence, and will not in the first instance be utilised to assume absence.

15.5.13 Nut searches should be conducted prior to the installation of nest tubes or boxes at any new sites. Where nest tube or box survey of sites has commenced and detailed surveys have not confirmed presence by the end of September 2012 then consultants undertaking survey should (where appropriate) conduct nut searches during October or November 2012. Nut searches should be targeted at the location of mature and heavily fruiting hazels where these are present.

15.5.14 Where nuts opened by dormice are identified during a nut search a specimen nut should be collected for future reference and sealed in a plastic bag with the following details:

- date sample collected (day/month/year);
- survey location and survey code (route zone-survey code-6 digit number);
- suspected species; and
- surveyor name.

15.5.15 Where dormouse presence is confirmed during the nut search any on-going or proposed nest tube/box survey at the survey site may be halted.

## 15.6 Survey programme and effort

15.6.1 Chanin and Woods (2003) defined a scoring system for nest tube and box survey based on the probability of finding dormice in a nest tube or box in any one month (see Table 8). Under this methodology a minimum cumulative score of 20 points must be reached to robustly determine presence/likely absence.

Table 8: Index of probability of finding dormice during nest tube or box survey in any one month

| Month | Index of Probability |
|---|---|
| April | 1 |
| May | 4 |
| June | 2 |
| July | 2 |
| August | 5 |
| September | 7 |
| October | 2 |
| November | 2 |

15.6.2 All nest tube or box surveys will be expected to obtain a cumulative score of 20 or above. Survey effort is determined by summing the index of probability scores from the month nest tubes or boxes are deployed to when they are removed (i.e. not just the months where the tubes are physically checked) as such nest tubes and boxes should ideally be placed out as soon as possible in the season at the required spacing and left for the duration.

15.6.3 All nest tubes and boxes should be checked once during August and again during September. Outside of these months checks should be conducted at least once every two months and immediately prior to removal.

15.6.4 Where the minimum cumulative score of 20 points is not achieved by the end of November 2012 and nut searches do not confirm presence then it will be necessary to conduct additional visits during 2013 until the required score is achieved.

15.6.5 Where visits during 2013 are required nest tubes and boxes should be left in-situ over the winter months and a check conducted during March 2013 to reposition or replace any tubes or boxes which have been dislodged or damaged.

15.6.6 Where conducted, nut searches should be carried until either (a) a confirmed nut opened by dormouse is located; or (b) until 100 nuts opened by other small mammals (i.e. not dormouse) have been found; or (c) until at least one and half hours has been spent searching.

15.6.7 Where access restrictions significantly constrain the period available for survey the number of tubes used should be doubled by reducing the spacing interval and thus doubling the monthly score. This will need to be highlighted as a potential limitation of survey.

## 15.7 References

Bright, P,, Morris, P,, and Mitchell-Jones, T, (2006). Dormouse Conservation Handbook. Second Edition. English Nature, Peterborough.

Chanin, P. and Woods, M. (2003). Surveying dormice using nest tubes: Results and experiences from the South West Dormouse Project. English Nature Research Report No. 524. English Nature, Peterborough.

Chanin, P. (2012). Personal correspondence.

Natural England (2011) Interim Natural England Advice Note - Dormouse surveys for mitigation licensing – best practice and common misconceptions. Natural England, Peterborough.

# 16 Bats

## 16.1 Introduction and guidelines

16.1.1 Proposed survey methodologies are largely based on the Bat Workers Manual (Mitchell-Jones and McLeish, 2004) [41], Bat Mitigation Guidelines (Mitchell-Jones 2004)[42] and Bat Surveys: Good Practice Guidelines 2nd Edition (Hundt, 2012)[43]. Reference has also been made to the survey methods recommended within Design Manual for Roads and Bridges Volume 10 (Highways Agency 2001)[44].

16.1.2 The following section details the scope of survey work and methodologies for these surveys. Determining the extent of survey will be an iterative process. Results of initial bat survey work are likely to identify the requirement for further surveys in some locations. Bat surveys focus on identifying features used by bats for roosting, as well as understanding how bats use the wider landscape for feeding and moving around. Initially, visual inspection is used to identify features with potential as bat roosts; this may then be supplemented by closer and more detailed inspection of some features with higher potential; and when inspection is not possible or the findings are not conclusive, dusk and dawn bat surveys are undertaken to identify any bats emerging and re-entering roost features. Following desk study, targeted bat activity surveys are used to identify movement and activity by bats around a site, including bat commuting routes and features that may be important in bat navigation/orientation.

16.1.3 It is known that bat species listed under Annex II of the EC Habitats Directive occur at locations in proximity to the proposed route. Detailed bespoke methodologies for such locations (and any others where the presence of Annex II species is suspected) will be devised in liaison with Natural England and, where appropriate, with local bat groups and researchers working in the area.

16.1.4 Consultants undertaking surveys should ensure that all descriptions of roost types utilised during the project are in line with the terms and definitions provided in Hundt (2012), as detailed in Table 9.

## 16.2 Qualifications and experience

16.2.1 All bat survey work conducted in support of the scheme will be conducted by suitably qualified persons. All work that is considered likely to result in disturbance of bats or their roosts will be conducted by holders of Natural England licences to 'take and disturb' bats for the purpose of science and conservation.

16.2.2 Some activities (e.g. initial assessments) may be suitable to be conducted by non-licensed but suitably experienced ecologists.

### Initial bat roosting potential assessments

16.2.3 Assessment of trees and buildings for roosting potential which does not result in disturbance may be conducted by all suitably qualified persons. All persons

[41] Mitchell –Jones, A.J., and McLeish, A.P. (2004), *Bat Workers' Manual*. Peterborough: Joint Nature Conservancy Council.
[42] Mitchell-Jones, A.J. (2004), *Bat Mitigation Guidelines (IN136)*. English Nature, Peterborough.
[43] Hundt, L. (2012), Bat surveys – *Good Practice Guidelines, 2nd Edition*. Bat Conservation Trust, London.
[44] Highways Agency (2001), *Design Manual for roads and Bridges – Volume 10 , Section 4, Part 3. Nature Conservation Advise in relation to bats*. Highways Agency, London.

conducting such a survey should be experienced in field survey of roosting potential of trees and buildings, including a good knowledge of the following:

- the legislation and protection afforded to bats;
- bat life cycle;
- locating and identifying field signs of roosting bats (droppings, scratch marks, urine staining etc.);
- using signs of bats found to locate likely roosting positions, likely genus of bat and type of roost;
- species-specific and seasonal requirements of roosting bats and the various natural features and manmade structures used for roosting;
- the range of survey methods that can be used to identify and study bats, and their strengths, weaknesses and limitations;
- describing construction of buildings and other structures, including the materials utilised and the form of features present (e.g. hipped roof, gable end, trussed rafters); and
- current relevant guidance for surveying bats.

16.2.4 If non-licensed surveyors identify evidence of an active roost during initial assessments then it will be necessary for them to cease surveying. The survey will subsequently be completed when a licensed surveyor is present.

### Internal survey

16.2.5 Surveys of known roosts, or potential hibernation roosts, should be undertaken by ecologists with the appropriate Natural England licence.

16.2.6 Survey teams conducting internal inspection of buildings/structures between May and September (when bats are most likely to be present) should include at least one Natural England licensed bat worker.

### Emergence/activity survey

16.2.7 It is recommended that each team of surveyors conducting emergence/return or activity surveys at a discrete location (i.e. a single tree, group of trees, building or structure) should include at least one licensed bat worker to coordinate the survey. At complex or large sites a higher proportion of licensed bat works should be utilised.

16.2.8 All other surveyors assisting in the implementation of emergence/activity surveys should have a sound knowledge and understanding of the following:

- the legislation and protection afforded to bats;
- bat life cycle;
- feeding strategies used by difference bat species;
- the physiology and flight characteristics of UK bats;

- the range of survey methods that can be used to identify and study bats, and their strengths, weaknesses and limitations;
- species specific and seasonal requirements of roosting bats and the range of features utilised by each species;
- using a range of bat detectors to identify species and record behaviour; and
- current relevant guidance for surveying bats.

### Further surveys

16.2.9 Any subsequent bespoke surveys for Annex II species will be overseen by licensed bat workers who are experienced in surveying, and assessing the impacts of development on, the species concerned. Licensed bat workers devising survey scope and methodologies on the project should have experience of undertaking ecological impact assessment in support of linear infrastructure projects, and designing successful mitigation schemes.

## 16.3 Licensing requirements

16.3.1 Requirements for the involvement of licensed surveyors are discussed within Section 16.2.

## 16.4 Screening for survey and defining the survey area

16.4.1 Aerial photograph interpretation (and where available Phase 1 habitat mapping and desk study records) will be utilised to identify all buildings, trees and other features with potential to provide a place of shelter for bats within the land required for the construction of the Proposed Scheme and within a surrounding 100m buffer of the boundary of the land required.

16.4.2 In addition consultants undertaking survey should conduct a review of all habitats, buildings, trees etc., and existing desk study records within a 500m buffer either side of the land required for the construction of the Proposed Scheme to identify any additional features where the following apply:

- there is the potential for significant effects on populations utilising these features; or
- information regarding bat use of the features/habitat in question will be important in determining a robust baseline that allows the significance of impacts within and in proximity to the Proposed Scheme to be accurately assessed.

16.4.3 An assessment of the need for survey of features more than 100m from the boundary of the land required for the construction of the Proposed Scheme should include consideration of the following:

- existing information on bat species, populations and roosts;
- protected sites, for example a Special Area of Conservation designated for bats;
- the context of the site in its surroundings;

- extent and quality of habitat within and around the site including water features, hedges, woodland and/or veteran trees;
- presence of known roosts or suitable buildings and other structures for roosts; and
- types of roost and species present (Hundt, 2012).

16.4.4 The scope of surveys will in the first instance be confined to habitats within a 100m buffer either side of the boundary of the land required for the construction of the Proposed Scheme, and features of particular interest within a 500m buffer of the boundary of the land required that are identified by the consultants responsible for bat survey in the area concerned. As the extent of the land required for construction will alter with design changes it will be necessary to regularly review which features require survey.

16.4.5 In urban sections the scope of survey will be limited to the land required for the construction of the Proposed Scheme (and the adjacent Network Rail Estate where the Proposed Scheme will run adjacent to existing rail lines) and any significant features/areas of semi-natural habitat adjoining the land required for the construction of the Proposed Scheme that are identified during aerial photograph interpretation. Within urban areas survey of retained residential housing adjoining the route should only be conducted where there is considered to be the potential for significant adverse effects.

## 16.5 Survey methods

16.5.1 The following methodologies are intended to provide robust baseline data on widespread UK bat species. If bat species listed on Annex II of the Habitats Directive[45] are found/ suspected to be present, additional survey work targeted at these species will be required to supplement the baseline.

### Definition of potential to support roosting bats

16.5.2 Whilst undertaking preliminary survey work, the surveyor should assign value to each feature within each building/tree in accordance with the scale set out in Table 9. Where surveyors consider it appropriate, the potential rating of a particular features may be upgraded based on professional judgement and/or prior knowledge of the site (e.g. an optimal feature on a tree located within sub-optimal surrounding habitat may normally be graded as moderate, but may be upgraded to high where the surveyor has prior knowledge of unusually high bat activity in its vicinity).

[45] Lesser horseshoe bat (*Rhinolophus hipposideros*),gGreater horseshoe bat (*Rhinolophus ferrumnequinum*), Barbastelle (*Barbastella barbastellus*) and Bechstein's bat (*Myotis bechsteinii*).

Table 9: Potential to support roosting bats

| Potential to Support Roosting Bats | Equivalent tree categories within Hundt (2012) | Description |
|---|---|---|
| Confirmed | Known or confirmed roost | A feature/structure within which bats are seen to be present (either live bats, or bat carcasses) or heard 'chattering' will be classified as a confirmed roost. In addition any feature/structure found to contain droppings during inspections will in the first instance be considered as a confirmed roost. N.B. In some cases it may be appropriate to revise this assessment following further survey (e.g. for buildings containing low numbers or old droppings and showing no evidence of use during emergence surveys). |
| High | Category 1* | A feature/structure which, due to its size, depth, shape, orientation or other physical properties (such as ability to maintain a constant temperature, accessibility for bats) is considered to be ideal for use by bats. Potential feeding remains, urine staining or scratch marks (in the absence of droppings) within or around the feature are likely to indicate presence of bat occupation and therefore suggest high potential that a roost is present. In the absence of such signs, assigning a feature high potential will also be informed by the surveyor's knowledge of bat ecology and preferred roost types (relative to the feature being assessed). The quality of the surrounding habitat for bats will also be considered. For example. a building within an area of woodland is more likely to be occupied by bats than one adjacent to large areas of hard standing (as the bats would use the woodland for feeding, and potentially roosting).<br>Potential examples of high potential features are:<br>• a south-facing opening on a tree trunk that appears to form a significant wound within the tree, with uncluttered drop zone and good connectivity to other areas of suitable habitat; or<br>• a gap below a ridge tile that provides a potential point of access to a pitched roof, with marked cleaner tile below indicating potential use by bats. |
| Moderate | Category 1 | A feature/structure which would be considered ideal for use by bats were it not for one or more key factors which limit its potential. For example, an ideal feature in sub-optimal surrounding habitat (e.g. within an area of predominantly hard standing) may be considered to have moderate potential. |
| Low | Category 2 | A tree/structure containing features where use by bats cannot be ruled out but is considered unlikely based on size, depth, construction aspect, habitat location etc. For example often metal warehouse structures with suitable access/egress points will be classed as having low potential to support roosting bats. |
| Negligible | Category 3 | A tree/structure which is considered to lack any features suitable for use by roosting bats. |

16.5.3 It should be noted that the initial assessment of potential considers only the potential to support any bat roost. As such it is possible to have a feature with a high potential to support roosting bats, even if this feature only has the potential to be utilised by a single bat.

## Assessment of buildings/structures for potential to support roosting or swarming bats

16.5.4 Buildings/structures (including natural structures such as caves or adits) identified as requiring survey (according to the criteria provided in Section 16.4) should be given a unique reference code (see Section 3) and assessed for their potential to support bat roosts and/or act as a swarming site. Surveys should include bridges and tunnels passing over/under the route of the Proposed Scheme.

16.5.5 Internal and external inspection of the structure for potential bat access/egress points and signs of bat activity should be undertaken and recorded as shown in Figure 2 (Hundt, 2012). A drawing should be made to show the layout of the structure, and the location, aspect and height of any features/signs of bats, and potential access/egress points.

16.5.6 Digital photographs should be taken (cross-referenced to a plan) to record all features within the exterior and interior of the structure for future reference. Photographs should be taken of any evidence of bats (such as distribution of droppings, urine staining etc.). However, all photography should ensure that it does not result in the disturbance of any bats currently in-situ.

16.5.7 Reference should be made to the glossary of architectural terms within the Bat Workers Manual (2004) when describing the construction of buildings.

16.5.8 Where droppings are found and cannot be identified definitively a small sample (considered to represent droppings from a single species) should be collected and sealed in a plastic bag marked with the following details:

- date sample collected (day/month/year);
- survey location reference (see Section 3);
- GPS coordinates;
- suspected species; and
- surveyor name.

16.5.9 The sample should subsequently be stored in a cool, dry place. DNA analysis will be conducted where appropriate on these samples to help confirm species present.

Figure 2: Standard information to be recorded during roost assessments of buildings and built structures

**Box 8.4 Standard information to be recorded in preliminary roost assessments of buildings and built structures**

| **Evidence of use by bats:** | **Features of the building or built structure:** |
|---|---|
| Location and number of any live bats.<br>Location and number of any corpses or skeletons.<br>Location and number of droppings.<br>Notes on relative freshness, shape and size of droppings.<br>Location and quantity of feeding remains.<br>Location of clean, cobweb-free timbers, crevices and holes.<br>Location of characteristic staining from urine and/or grease marks.<br>Location of known and potential access points to the roost.<br>Location of the characteristic smell of bats if no other evidence is recorded. | Type.<br>Age.<br>Aspect.<br>Wall construction, in particular the type of brick or stone used to build the walls and whether it has cavity walls or rubble-filled walls.<br>Form of the roof, in particular the presence of gable ends, hipped roofs, etc. and the nature and condition of the roof covering.<br>Presence of hanging tiles, weather-boarding or other forms of cladding.<br>Nature of the eaves, in particular if they are sealed by a soffit or boxed eave and the tightness of the fit to the exterior walls.<br>Presence and condition of lead flashing.<br>Gaps under eaves, around windows, under tiles, lead flashing etc.<br>Presence and type of roof lining.<br>Presence of roof insulation.<br>Presence of water tanks in loft (note if covered or uncovered).<br>Structure of the roof including the truss type, age and nature of timber work.<br>Information or evidence of work having been undertaken that could affect use of the structure by bats. |

Source: Bat Surveys – Good Practice Guidelines 2nd Edition (Hundt, 2012).

16.5.10 Wherever possible and safe to do so, surveys should access all areas including cellars/underground structures and loft spaces. High-powered torches with red filters, binoculars and endoscopes should be used to investigate all accessible areas. Where there are any constraints to the survey these should be clearly identified in the survey notes and consideration given to the effect these constraints may have had on the results obtained.

16.5.11 Each building/structure should be classified according to its potential to support roosting bats during the active season as confirmed, high, moderate, low or negligible based on Table 9.

16.5.12 In addition surveyors should, where possible, also give an indication of the type of roost the building structure is considered most likely to support based on current evidence (e.g. summer maternity roost, transitory roost, feeding perch, swarming site or hibernation roost) and/or the number of bats it is considered to have the potential to support on a three point scale of small, medium or large. It is acknowledged that for many features classification under these criteria may not be possible based on initial inspection alone.

16.5.13 Where buildings are confirmed roosts or are considered to have moderate or high potential to support a roost; or where a full inspection cannot be undertaken due to access restrictions (e.g. unsafe structure), then subsequent evening emergence and dawn re-entry surveys will be required. Given the evolving nature of the design, the requirement for emergence survey in relation to buildings applies in the first instance to all buildings within the survey scope (i.e. with the exception of urban areas, those located within the land required for construction of the Proposed Scheme or within a 100m buffer either side of the current boundary of the land required, or specific features within a 500m buffer where potential significant effects are anticipated). As design stabilises professional judgement may be applied to limit survey outside of the land required for the construction of the Proposed Scheme to those locations where there is considered to be the potential for significant effects.

16.5.14 No further survey is required of buildings/structures assessed to have low or negligible potential but sufficient information will need to be collected to give confidence to this assessment. As a precaution the procedure for demolition of low potential buildings is likely to include reasonable avoidance measures.

16.5.15 Each building/structure subject to initial assessment should also be assessed for its potential to support hibernating bats or act as a swarming site. Assessment should in this case simply classify sites as having potential for hibernation/swarming or lacking hibernation/swarming potential. All buildings/structures identified as having hibernation or swarming potential will require further survey as described later in this section.

## Assessment of trees for potential to support roosting bats

16.5.16 As a general rule in the first instance all trees of diameter at breast height of 0.25m or above within the land required for the construction of the Proposed Scheme or within a 100m buffer either side of it should be subject to survey from ground level by a suitably experienced ecologist (i.e. one with knowledge of tree roosting in bats). Binoculars will be used to inspect the canopy of the tree for evidence of the features listed in the box overleaf, with each feature graded based on its potential to support roosting bats (see Table 9).

16.5.17 All trees should be given unique reference codes (see Section 3), with the location mapped and cross referenced to photographs taken. Preliminary surveys of trees should, ideally, be undertaken before trees come into full leaf. Where this is not possible and leaf cover is considered to significantly obscure initial inspection then

trees should be given a precautionary 'high' grading, triggering the requirement for future climb-and-inspect survey.

16.5.18 In addition surveyors should, where possible, also give an indication of the type of roost the feature is considered most likely to support based on current evidence (e.g. summer maternity roost, transitory roost, feeding perch, swarming site or hibernation roost) and/or the number of bats it is considered to have the potential to support on a three point scale of small, medium or large. It is acknowledged that for many features classification under these criteria may not be possible based on initial inspection alone.

## Climb-and-inspect survey (trees)

16.5.19 Any trees where the presence of a roost has been confirmed during the initial assessment will not be subject to climb-and-inspect survey and should instead progress directly to emergence survey.

16.5.20 Subject to the exceptions listed in paragraph 16.5.21 below all trees that are considered to contain the following features will be subject to further inspection:

- trees identified during the initial inspections as containing features with high or moderate potential to support roosting bats during the 'active' period; or
- features with potential to support hibernating bats.

16.5.21 It is acknowledged that not all trees will be considered safe to climb and for all trees where this is true a clear record should be made. In addition where the only features on a tree triggering the requirements for climb-and-inspect survey are either ivy cover or relatively open features that can be viewed fully from the ground using a torch (e.g. a callus roll) then no climb-and-inspect survey is required.

16.5.22 All inspections should be conducted either by a trained tree climber who is also a Natural England licensed bat worker, or by a tree climber under the direct supervision of a licensed bat worker. In order to minimise the risk of disturbance during inspections all tree climbers who are not licensed bat workers will be briefed by a bat worker who is experienced in undertaking tree inspections.

16.5.23 Climb-and-inspect surveys should, ideally, be undertaken between May and September when bats are more likely to be present. They will continue to provide useful information regarding the exact nature of features outside of this period. However, a more precautionary approach should be taken to the scoping out of further survey when inspections are conducted outside of this ideal period. Based on the results of the climb-and-inspect survey initial gradings will be reviewed and re-graded where necessary according to Table 9.

16.5.24 Where confirmed evidence of bats is found during the climb-and-inspect survey, or features cannot be investigated in full, emergence/re-entry surveys will be required. Emergence survey will also be conducted on the following:

- all trees containing high potential features (based on the outcome of the further inspection) which will either be subject to works or may be subject to potentially significant effects (e.g. through severance of habitat features utilised during foraging, commuting or navigation; disturbance through lighting or noise etc.); and

- all trees containing moderate potential features which could not be investigated fully during climb-and-inspect surveys.

16.5.25 Features assessed to have low or negligible potential to support roosting bats (following inspection and re-grading), where no evidence of bats is identified, will be scoped out of further survey work.

16.5.26 Should climbing surveys be deemed unsafe or otherwise not possible, any trees containing either high or moderate potential features should be subject to dusk emergence and dawn re-entry surveys.

## Dusk emergence and pre-dawn re-entry surveys

16.5.27 The minimum level of survey for buildings/structures and trees requiring additional survey in the form of evening emergence and dawn re-entry surveys is detailed in Table 10. In each case the level of survey for the tree, building or structure in question will be defined by the highest potential feature which it supports (i.e. survey effort for a tree containing both high and moderate potential features will be three dusk emergence and/or pre-dawn emergence surveys). It should be noted that trees containing moderate potential features should only be subject to emergence survey where it was not possible to fully inspect these features during climb-and-inspect surveys. Surveys should be undertaken between May and August[46].

Table 10: Minimum number of emergence and re-entry survey visits for high and moderate potential trees and buildings

| High bat roosting potential | Moderate bat roosting potential |
|---|---|
| Three dusk emergence and/or pre-dawn re-entry surveys during May to August | Two dusk emergence and/or pre-dawn re-entry surveys during May to August |

Source: Bat Surveys – Good Practice Guidelines 2nd Edition (Hundt, 2012).

16.5.28 In each case at least one of the surveys should be a pre-dawn re-entry survey. In addition it should be noted that two surveys carried out within the same 24 hour period only constitutes one survey (i.e. a dusk emergence immediately followed by a pre-dawn re-entry only represents a single survey visit).

16.5.29 Once the minimum standard is completed consultants undertaking survey work should consider the requirement for additional visits on a case by case basis.

16.5.30 Surveyors will use frequency division or time expansion echolocation detectors. Detectors will be either recording detectors or be connected to a digital recording devices (such as the Edirol R-09), allowing recordings to be made as .WAV files or in a format that can be converted to .WAV format. This will enable calls to be analysed in either Bat Sound or Bat Scan software.

16.5.31 Static monitoring devices such as Anabat or SM2BAT+ may be utilised as a mobile recording device during emergence surveyors. However, in all cases surveyors should also be equipped with a stand-alone detector and headphones. Static monitoring devices should only be used to replace surveyors during emergence surveys at locations where there are health and safety issues.

[46] Based on access constraints and an exceptionally wet summer during 2012 consultants undertaking survey should consider the merits of conducting surveys into September/October 2012 with repeat visits during 2013. In many cases, the minimum requirement in relation to emergence survey will be achieved through a combination of visits from both 2012 and 2013.

16.5.32 Surveyors are to be positioned in sufficient numbers that all potential roost features can be seen by at least one surveyor. All surveyors will be briefed prior to the start of survey as to the findings of the preliminary assessment and shown the presence of any potential access/egress points. Surveyors will remain at their survey station throughout the emergence survey period (i.e. dusk emergence and pre-dawn re-entry surveys should not be combined with activity surveys and surveyors moving between multiple roost features during a survey represents insufficient coverage).

16.5.33 In some locations consultants undertaking survey may find it useful to conduct emergence survey of trees or buildings which contain suitable features and occur in close proximity as part of a single larger survey. This approach is acceptable assuming that the number of surveyors utilised remains sufficient to ensure that all potential roost features are visible by at least one surveyor at all times.

16.5.34 Evening emergence surveys are to be undertaken from 15 minutes before sunset until two hours after sunset; and pre-dawn re-entry surveys undertaken from two hours before sunrise until sunrise. A record of weather conditions including air temperature, cloud cover and wind speed is to be made at the start and end of the survey period together with casual recordings made of any changes in weather conditions for the duration of the period, such as rain showers, and sunset and sunrise times. During the survey, a record of the number of bat passes of each species is to be made together with additional information such as direction of flight, emergence/re-entry point and activity recorded.

16.5.35 Following survey work, all recordings are to be analysed by an experienced ecologist using call analysis software to confirm species (where possible) and number of passes made. All recordings are to be retained for future reference.

16.5.36 All emergence surveys should be conducted during suitable weather conditions as defined in Hundt (2012).

### Back tracking surveys

16.5.37 At locations where a group of trees meet the criteria for further survey, it may be appropriate to utilise back tracking survey as an alternative to emergence/pre-dawn re-entry surveys in order to locate roosts and gain a greater understanding of the bat assemblage supported by these features.

16.5.38 There is no widely accepted guidance on the number of survey visits required for back tracking survey, or the number of surveyors required in order to conduct reliable back tracking survey; the number of surveys and number of surveyors required will vary depending on the location and nature of the features to be subject to survey. It is expected that there will be no more than a 50m spacing between surveyors.

16.5.39 In the evening, back tracking surveys are to cover the period from half an hour before sunset to two hours after sunset, and for pre-dawn surveys the period at least two hours before sunrise.

16.5.40 The number of survey visits required to give a robust indication of the location of roosts may vary depending on the survey location. However, as a guide it is anticipated that at all locations this should as a minimum include dusk and pre-dawn

(or pre-dawn and dusk) surveys in the same 24hr period on at least two occasions (i.e. 2 x dusk/dawn or 2 x dawn/dusk) during the period May to August[47].

16.5.41 It is expected that all back tracking exercises will utilise static detectors to augment the total dataset. Where back tracking survey confirms the presence of roosts then emergence survey should be undertaken according to requirements set out in Table 10.

16.5.42 In order to ensure that levels of survey effort are comparable for similar survey scenarios consultants undertaking further survey work will be required to submit a deviation request for approval. Each deviation request should include the following details:

- aerial photograph annotated to show the location of features identified which require further survey;
- proposed number of surveyors;
- proposed number of survey visits;
- proposed timing of visits (i.e. one visit during September 2012, one during April 2013 etc.); and
- brief rationale for use of methodology at this location including summary of results from initial inspections.

## Bat activity surveys (walked transect)

16.5.43 Within each 10km section of the route, a minimum of 3km of bat activity transect should be undertaken. This does not need to be a continuous 3km, and can be divided into sections to target features of particular interest and potential impact within and outside the land required for the construction of the Proposed Scheme, based on review of desk study data, aerial mapping and Phase 1 habitat survey data (where available). Where the 10km section contains significant extents of bored tunnel the minimum effort may be reduced.

16.5.44 In areas of high quality habitat for bats or where significant effects are otherwise considered likely (e.g. as a consequence of severance, loss of foraging habitat or disturbance), the consultant undertaking the survey is to undertake additional transect routes (i.e. in addition to the minimum of 3km within every 10km section) to assess likely significant effects on bats.

16.5.45 The aim of the surveys is to give an indication of species and numbers of bats utilising habitat within and in the vicinity of the land required for the construction of the Proposed Scheme, and to give an indication of existing features within the landscape that may be important in bat foraging, navigation and orientation and may be adversely affected as a consequence of the construction and/or operation of the Proposed Scheme.

16.5.46 The transect routes should in general focus on features which may act as bat flight lines (such as hedgerows and watercourses) which may be severed or adversely affected as a consequence of construction and/or operation of the Proposed Scheme,

[47] Based on access constraints and an exceptionally wet summer during 2012 consultants undertaking survey should consider the merits of conducting surveys into September/October 2012 with repeat visits during 2013.

and potential roost sites such as bridges, buildings and mature trees within the land required for the construction of the Proposed Scheme and a 100m buffer either side of it.

16.5.47 Features outside the land required + 100m buffer are only to be included where they are considered to be of value in identifying and assessing significant effects on bats (in particular as a consequence of severance).

16.5.48 Transect routes should be planned by an experienced bat ecologist utilising aerial photographs, Phase 1 habitat survey data and site photographs. Between 10 and 12 listening station stops (three minutes per stop) should be incorporated per transect route. Each transect route should take two to three hours to complete (Hundt, 2012).

16.5.49 Prior to conducting the first survey visit at least one member of the survey team should have visited the transect route during daylight hours in order to ensure that access constraints (e.g. fencing, hedges and other obstacles) have been considered and confirm that the location of listening station stops are appropriate. If one of the survey team is already familiar with the site from previous visits for other surveys then no additional visit will be required. Once the transect route and listening station stops have been selected, transects will be walked at a steady speed by an experienced ecologist using a bat detector and recording device.

16.5.50 All surveys should be conducted during suitable weather conditions as defined in Hundt (2012).

16.5.51 Surveyors will use frequency division or time expansion echolocation detectors. Detectors will be connected to a digital recording devices (such as the Edirol R-09), allowing recordings to be made as .WAV files or in a format that can be converted to .WAV format. This will enable calls to be analysed in either Bat Sound or Bat Scan software.

16.5.52 Monitoring devices such as Titley Anabat SD2 or Wildlife Acoustics SM2BAT+ may be utilised as a mobile recording device during activity survey. However, in all cases at least one surveyor should also carry a hand held detector (and headphones) with frequency division or time expansion capability and linked recording device.

16.5.53 Transect surveys are to be undertaken from sunset until two hours after sunset or until the full transect length has been walked (whichever is later) and for at least two hours before sunrise until sunrise. A record of weather conditions including air temperature, cloud cover and wind speed is to be made at the start and end of the survey period together with casual recordings made of any changes in weather conditions for the duration of the period, such as rain showers, along with sunset and sunrise times. During the survey, a record of the number of bat passes of each species is to be made together with additional information such as direction of flight, any emergence/re-entry points and activity recorded.

16.5.54 Where access allows each activity transect should be repeated as a minimum on three occasions between June and August with at least one of the three surveys comprising dusk and dawn surveys within one 24-hour period (i.e. dusk activity followed immediately by pre-dawn survey equates to one visit). The consultant undertaking surveys should consider the requirement for additional survey visits in areas of particularly suitable habitat. The start point and direction of transects should be varied between visits.

16.5.55 Each activity transect identified should also be subject to a minimum of one dusk/dawn survey (i.e. dusk activity followed immediately by pre-dawn survey) during the following months September 2012, October 2012, April 2013, May 2013, June 2013). Where habitat quality is high, or there is considered to the potential for significant effects on bats then the requirement to undertake additional visits (i.e. above the 1 per month minimum requirement) should be considered.

16.5.56 During activity surveys, where bat roosting is confirmed through observation, additional emergence/re-entry surveys may be required and should be undertaken in line with the methodology outlined above.

16.5.57 If Annex II bat species are recorded or suspected, the scope of additional survey work should be agreed through the deviation request process.

16.5.58 Following survey work, all recordings are to be analysed by an experienced ecologist and confirmation of species and number of passes made. All recordings are to be retained for future reference.

### Bat activity (car-based transect)

16.5.59 In those areas of significant land access refusals, driven transects on local roads should be utilised where appropriate to maximise available baseline data.

16.5.60 A methodology for car based transects is provided in Appendix C.

16.5.61 It should be noted that prior to conducting any car based transects consultants undertaking survey must submit a risk assessment for the proposed survey. It will be the responsibility of the consultant undertaking the survey works to notify the local highways authority and any other necessary parties (including the police as appropriate).

16.5.62 It should be noted that in central London and other busy urban areas the use of this methodology is considered unlikely to be acceptable on health and safety grounds.

### Automatic detectors

16.5.63 Within each 10km of route requiring bat activity surveys, a minimum of two automated echolocation detectors are to be installed at suitable points (e.g. at hedgerow crossings) along the route alignment as determined by an ecologist experienced in their use, in order to provide additional data to assist in assessing the impact of habitat severance.

16.5.64 Consultants undertaking the surveys should also consider the requirement for additional echolocation detectors (i.e. in addition to the minimum of two per 10km route section) at suitable points to assist in determining the impact of habitat loss, severance or activity in the vicinity of known/suspected roosts.

16.5.65 Where only the minimum number of automated detectors are deployed they should be placed at least 2km apart unless the landscape pattern means that there is good reason to have closer spacing. Where additional detectors are utilised these may be deployed as required in order to help in the assessment of likely significant effects on bats.

16.5.66 Detectors should be in place and recording for at least seven consecutive nights per month between May 2012 and October 2012 and during the period April 2013 to June

2013. Detectors will need to be positioned in water-proof cases and checked on a monthly basis to collect data.

16.5.67 To give consistency across hardware, automated detectors should either be Titley Anabat SD2 or Wildlife Acoustics SM2BAT+ recording in zero crossing mode. This will allow data from the two types of detectors to be analysed using the Analook software.

16.5.68 Analysis should be undertaken using the Analook software, and bat calls recorded tabulated against time and the location of the recording device.

### Hibernation site surveys

16.5.69 If initial survey identifies buildings/structures with the potential to act as bat hibernation sites, these will need to be surveyed by an ecologist with a Natural England licence to disturb hibernating bats.

16.5.70 Two visits are required, one in mid-January 2013 and one in mid-February 2013.

16.5.71 The site should be searched systematically from the entrance, with the locations of any bats seen marked on a plan of the site.

16.5.72 Careful inspection for droppings or oil staining around cracks and crevices, including rock piles, may also yield evidence of use by bats. Detailed records will be made of the location of any bats and/or signs of bats identified. In addition accurate temperature (°C) and relatively humidity (%) readings should be taken during each visit. It is assumed that a full description of the potential hibernation site, including details of construction and potential perching points will have been made as part of the initial assessment.

### Autumn swarming survey

16.5.73 If initial survey or desk study/consultation identifies potential autumn swarming sites, the following survey methodology should be applied in line with Hundt (2012).

16.5.74 One survey per month should be undertaken between August and October. An automated echolocation detector (Anabat SD2 or SM2BAT+ in zero crossing mode) should also be left in place at each potential swarming site under investigation for the period August to October.

16.5.75 Surveys should be undertaken on relatively warm, calm and rain-free evenings. Surveys should begin at 1 hour after sunset and continue for up to 4 hours.

16.5.76 During the survey, a record of the number of bat passes of each species is to be made together with additional information such as direction of flight, any emergence/re-entry points and activity recorded.

16.5.77 Surveyors will use frequency division or time expansion echolocation detectors. Detectors will be connected to a digital recording devices (such as the Edirol R-09), allowing recordings to be made as .WAV files or in a format that can be converted to .WAV format. This will enable calls to be analysed in either Bat Sound or Bat Scan software.

### Mist netting/harp trapping/radio-tracking

16.5.78 If more detailed survey work including mist netting, harp trapping or radio-tracking is required this will need to be agreed via the deviation request process. Use of such methods will only be accepted where there is no alternative suitable means of collecting these data. In these circumstances an application for a project specific licence to undertake these surveys would need to be submitted to Natural England.

## 16.6 Survey programme and effort

16.6.1 Timing of survey work is detailed in the survey methodology section above, summarised in Table 11 below.

Table 11: Summary of bat survey programme and effort

| Survey | Programme | Effort[48] |
|---|---|---|
| Building inspections | Year round (optimum period between May and September) | Any buildings identified during the habitat surveys as likely to be suitable for occupation by bats and which may be affected by the Proposed Scheme (demolition, disturbance, modification) should be investigated in more detail for evidence of use by bats. |
| Assessment of trees for potential to support roosting bats | Year round (assuming a precautionary approach is adopted during periods of dense leaf cover ) | Any tree of 0.25m DBH or above within the land required for the construction of the Proposed Scheme and a 100m buffer either side of the land required and any other significant trees will be investigated in more detail for evidence of use by bats. |
| Tree climber inspections | Year round (optimum period between May and September) | Trees with moderate or above potential to support roosting bats. |
| Dusk emergence and dawn re-entry surveys | May to August | High roosting potential: three dusk emergence and or pre-dawn emergence between May and August.<br>Moderate roosting potential two dusk emergence and/or pre-dawn surveys during May to August. |
| Activity surveys | June 2012 to October 2012 and April 2013 to June 2013. | Minimum of three surveys undertaken between June and August 2012 with at least one of the three surveys comprising dusk and dawn within one 24-hour period. One dusk and dawn (within a 24 hr period) during September 2012, October 2012, April 2013, May 2013 and June 2013. |
| Automated detector survey | May 2012 to October 2012 and April 2013 to June 2013 | Data collected for at least seven consecutive nights per month between May and September. Checked on a monthly basis to collect data. |
| Autumn swarming | August to October | One survey per month between August and October. |
| Hibernation survey | January 2013 and February 2013 | Two visits are required, one in mid-January and one in mid-February. |

## 16.7 References

Highways Agency (2001). Design Manual for Roads and Bridges – Volume 10- Section 4 Part 3 Nature conservation advice in relation to bats. Highways Agency, London.

Hundt, L. (2012). Bat Surveys – Good Practice Guidelines 2nd Edition. Bat Conservation Trust, London.

Mitchell-Jones A, J. (2004). Bat Mitigation Guidelines (IN136). English Nature, Peterborough.

[48] Access constraints mean that the full survey effort will not be achieved at all sites selected for survey.

Mitchell-Jones, A. J., and McLeish, A. P. (2004). Bat Workers' Manual. Peterborough: Joint Nature Conservancy Council.

# 17 Otter

## 17.1 Introduction and guidelines

17.1.1 There is the potential for adverse effects on otter (*Lutra lutra*) particularly where watercourses pass through or in close proximity to the land required for the construction of the Proposed Scheme. Given the on-going expansion in the distribution of the otter, it is considered important to identify both locations which are currently utilised by otter and those which are suitable for use by otter in the future.

17.1.2 In addition, the survey will take into account the use of terrestrial habitat by otter including location of both actual and potential holts (i.e. underground resting sites) and of couches (i.e. above-ground resting sites), and linear routes that may be important for movement between watercourses.

17.1.3 The proposed survey methodology draws largely upon the guidance provided in the Design Manual for Roads and Bridges (DMRB) Volume 10 Section 4 Part 4 (Highways Agency, 1999)[49].

## 17.2 Qualifications and experience

17.2.1 Habitat assessment and selection of sites for further survey is to be conducted by persons with awareness of the range of habitats utilised by otter, including knowledge of terrestrial features utilised during breeding.

17.2.2 All surveyors should have experience of the following:

- identification of otter field signs;
- differences between signs of otter and other species which can be confused with otter, including mink;
- otter behaviour and habitat requirements; and
- identifying potential impacts of seasonal conditions or weather conditions on the validity of survey results.

17.2.3 An otter specialist is to lead surveys wherever possible due to the complexity of finding and identifying holts and couches in particular when distant from watercourses.

## 17.3 Licensing requirements

17.3.1 No licence is required to conduct otter survey assuming that care is taken to avoid disturbance of potential couches and holt locations. No survey that would result in disturbance of otter, or their places of rest is proposed as part of the current survey. Where monitoring of holts is required, non-invasive techniques such as the use of appropriately placed infra-red cameras will be utilised.

[49] Highways Agency (1999), *Design Manual for Roads and bridges – Volume 10, Section 4, Part 4. Nature Conservation Advise in relation to Otters.* Highways Agency, London.

## 17.4 Screening for survey and defining the survey area

17.4.1 Initially a review of desk study data, OS mapping and aerial photographs is to be undertaken to identify all watercourses and water bodies that fall within a 100m buffer of the land required for the construction of the Proposed Scheme and any others where there is considered to be the potential for the Proposed Scheme to result in significant adverse effects on otter. Where available, results of the Phase 1 habitat survey, River Corridor Survey, and ditch and pond surveys will inform this screening exercise.

17.4.2 It is expected that all watercourses which pass within a 100m buffer of the land required for the construction of the Proposed Scheme will require habitat assessment. Watercourses/water bodies would only be scoped out where significant barriers to movement occur between this feature and the land required for construction of the Proposed Scheme.

17.4.3 A walkover of each site selected for survey will be conducted by an experienced surveyor, and a decision taken on the need for subsequent detailed survey. This assessment should include consideration of each site against the following criteria:

- proximity to the land required for construction of the Proposed Scheme;
- presence of significant barriers to dispersal and movement through the territory;
- habitats present and suitability for use by otter (including terrestrial habitats);
- adjoining land use;
- level of disturbance;
- features of watercourse/water body (estimated depth, level of flow, width of channel);
- connectivity with other areas of suitable or sub-optimal habitat; and
- pollution.

## 17.5 Survey methods

### Aquatic/riparian habitats

17.5.1 For watercourses selected for detailed survey, initially a 2km section either side of the boundary of the land required for the construction of the Proposed Scheme was surveyed. Where a confluence with a river was reached more than 1km from the boundary of the land required and there are no signs of otter activity in the vicinity of the confluence, the survey was terminated at this point.

17.5.2 Surveys conducted post-November 2012 should utilise a revised survey extent of a minimum of 300m either side of the boundary of the land required for the construction of the Proposed Scheme. The reduction in extent follows correspondence with Natural England. The reduced survey effort is appropriate given that a commitment has been made that the undertaker will ensure that the Proposed Scheme maintains safe passage for otter at all watercourses potentially suitable (i.e. including those which are yet to be repopulated by otter).

17.5.3 Where possible both banks should be surveyed. Where necessary spot checks should be conducted at suitable publicly accessible areas within 5km of the land required for the construction of the Proposed Scheme (Highways Agency, 1999).

17.5.4 For water bodies, the survey should include all areas that fall within a 100m buffer from the land required for the construction of the Proposed Scheme and a minimum 300m section either side of this (Highways Agency, 1999).

17.5.5 For all sections of aquatic/riparian habitat subject to survey, all evidence of otter and other notable species such as water vole and mink should be recorded. This should as a minimum include the number and location of the following field signs:

- natal holts, holts and potential holt sites (using the criteria provided in Appendix D);
- couches ;
- spraints;
- anal jelly;
- tracks/footprints;
- silt/sand heaps; and
- slides.

17.5.6 All field signs of otter, along with those of any other notable species (in particular mink and water vole) should be provided with GPS derived grid coordinates accurate to less than 5m. Where topography and vegetation structure may have reduced the accuracy of records below this level, this information should be noted.

17.5.7 When searching for potential holt sites the criteria devised by Chanin (2012)[50] provided in Appendix E should be utilised as the basis for identifying potential holt sites and determining whether or not they are in use.

17.5.8 Where the presence of otter is confirmed, and significant adverse effects are likely, there may be a requirement to extend the extent of survey into other adjacent watercourses (which may have been scoped out at an earlier stage), and for the use of additional survey methods including use of camera traps.

## Terrestrial habitat

17.5.9 Where land required for the construction of the Proposed Scheme is located within 100m of a watercourse or water body that is confirmed as being utilised by otter, a review of aerial photography, and walkover survey (where required) should be conducted to check for the presence of any features within the land required that may be utilised as couches, resting places or natal holts.

17.5.10 The following criteria devised by Chanin (2012) should be utilised to identify potential otter breeding sites:

- any single area of extensive concealing habitat (woodland, scrub, reedbed) which is greater than 1ha in area and within 100m of a watercourse; and

[50] Chanin, P. (2012). Personal correspondence.

- any combination of extensive concealing habitats which are within 100m of one another, total at least 1ha and are within 100m of a watercourse.

17.5.11 For all potential breeding sites identified using these criteria a site visit should be conducted by an experienced otter surveyor to check for signs of breeding activity (e.g. well used paths, play areas, or large accumulations of spraint). During this visit their overall suitability should be scored on a scale of 0= unsuitable to 5 = highly suitable taking into consideration the criteria for assessing cover and suitability of food shown in Appendix D devised by Chanin (2012).

17.5.12 The location of any such feature identified should be recorded, along with details of the feature and associated habitat (e.g. large wood pile within area of semi-natural woodland).

17.5.13 In addition, the survey should look to identify and map any linear features that may be important in the movement of otters between adjacent watercourses.

## 17.6 Survey programme and effort

17.6.1 Where access restrictions allow, a total of four survey visits should be conducted at approximately three-monthly intervals. However, where no habitat suitable for the creation of holts or couches is present within the land required for the construction of the Proposed Scheme then survey may be curtailed once the presence of otter has been confirmed.

17.6.2 Survey should not be conducted during or following periods of heavy rainfall, as field signs will have been washed away. In general where possible survey visits should be timed to avoid survey when water levels are high.

## 17.7 References

Chanin P (2003). Monitoring the Otter (*Lutra lutra*). Conserving Natura 2000 Rivers Monitoring Series No. 10, English Nature, Peterborough.

Chanin P (2005). Otter surveillance in SACs: testing the protocol. English Nature Research Reports - Number 664, English Nature, Peterborough.

Chanin P (2012) Personal correspondence.

Highways Agency (1999). Design Manual for Roads and Bridges – Volume 10 – Section 4 Part 4 – Nature Conservation Advice in Relation to Otters. Highways Agency, London.

IEEM (2011). Competencies for Species Surveys: Eurasian otter IEEM, Winchester. Downloaded at http://www.ieem.net/docs/CSS%20-%20EURASIAN%20OTTER%20%2831.8.2011%29.pdf on 8 March 2012.

# 18 Water vole

## 18.1 Introduction and guidelines

18.1.1 Survey for water vole (*Arvicola amphibius*) will need to take account of all watercourses that pass through or in close proximity to the land required for the construction of the Proposed Scheme including canals, where populations are thought to be surviving better than on rivers.

18.1.2 The proposed approach will follow the Water Vole Conservation Handbook (Strachan et al, 2011)[51] survey methodology, taking into account current Natural England advice (Natural England, 2008;[52] Natural England, 2011[53]).

## 18.2 Qualifications and experience

18.2.1 All initial scoping and habitat assessment work should be conducted by persons with previous experience of the range of habitats utilised by water vole and of field signs indicating potential presence of water vole.

18.2.2 A detailed search of the survey area in question should be undertaken by an experienced water vole surveyor. This should be a surveyor who has undertaken sufficient similar surveys in the past to enable a suitable level of confidence in identifying the field signs of water vole.

## 18.3 Licensing requirements

18.3.1 No licence is required to survey for water vole. Care should be taken during survey not to disturb water vole if present.

## 18.4 Screening for survey and defining the survey area

18.4.1 Initially review of desk study data, aerial photography and habitat mapping was undertaken to identify and map all areas of habitat potentially suitable to support water vole that are located within the land required for the construction of the Proposed Scheme, or within a 500m buffer of the boundary of the land required. This initial assessment included identification of all watercourses, ponds and lakes within this extent, and any other suitable riparian habitat (e.g. reedbed).

18.4.2 Where the above desk based exercise or the results of other surveys (e.g. Phase 1 habitat survey) identify the potential for, or signs indicating the presence of water vole, a specific walkover survey will be conducted in order to appraise the potential suitability of the habitat present for water vole in more detail, and determine the scope of detailed survey. The habitat assessment should be based on consideration of the following factors:

- bank profile, channel profile and characteristics, and water levels;
- availability of food sources;

[51] Strachan, R., Moorhouse T. and Gelling, M. (2011). *Water Vole Conservation Handbook – Third edition*. Wildlife Conservation Research Unit, Oxford.
[52] Natural England (2008). *Water voles – the law in practice. Guidance for planners and developers (NE 86)*. Natural England, Peterborough.
[53] Natural England (2011). *Natural England Technical Information. Note TIN042: Water voles and development: licencing policy*. Natural England, Peterborough.

- vegetation structure (in particular the extent of suitable marginal vegetation);
- level of shading;
- disturbance levels;
- bordering land use; and
- connectivity with other areas of suitable or sub-optimal habitat.

18.4.3 Based on the above factors and any others which the surveyor considers to be important in the local context, habitat areas requiring detailed survey are to be determined, as well as areas that can be discounted from further investigation.

## 18.5 Survey method

18.5.1 At each site selected, a detailed water vole survey should take place following the survey guidelines set out in the Water Vole Conservation Handbook (Strachan et al, 2011).

18.5.2 Survey undertaken up to November 2012 included the land required for the construction of the Proposed Scheme and a 500m upstream and 500m downstream extent from the boundary of the land required where access allowed. This extent has been reduced to the land required and a 300m extent upstream and downstream (where access allowed) for surveys conducted from November 2012 onwards. The reduction in scope followed correspondence with Natural England and a commitment that the undertaker will ensure that all culverts of suitable watercourses will maintain safe passage.

18.5.3 Each survey area should be split into 50m-100m lengths with the start and end of each stretch marked on a map and the GPS coordinate recorded for the beginning and the end of the length. The lengths/areas surveyed are to be mapped and all signs of water vole plotted accurately on a plan with a GPS coordinate taken.

18.5.4 Wherever possible, the survey should be undertaken from within the watercourses, in order to allow for a close search for signs of water vole. Consultants undertaking survey should consider carrying out surveys from a boat in places where water is deep and the margins cannot be safely surveyed from the bank.

18.5.5 During each survey visit the banks of each watercourse/water body (up to a distance of 2m from the edge of the water) should be inspected for signs of use by water vole including the following:

- presence of latrines;
- presence of burrows (both active and inactive);
- presence of runs;
- presence of footprints;
- presence of feeding remains;
- individual droppings; and

- sightings and/or sounds (characteristic sound entering the water) of individuals.

18.5.6 As well as marking all signs on a map, a note should be made of the number of each type of sign recorded so that abundance can be estimated.

18.5.7 The above information will be recorded alongside similar information indicating use by other species (e.g. bank vole, field vole, mink, otter, brown rat, etc.). The location of all positive evidence of the presence of both water vole and any other species identified during the survey (e.g. bank vole, mink, brown rat, etc.) should be recorded by GPS (to an accuracy of <5m where terrain/vegetation allows).

18.5.8 For each watercourse/water body subject to survey the following additional information should be collected during the first survey visit:

- habitat types present;
- predominant bank substrate;
- adjoining land use;
- vegetation types present and indication of abundance of each using DAFOR scale;
- disturbance at the site;
- bank profile;
- depth;
- width;
- rate of flow;
- signs of recent habitat damage; and
- sketch map of the site.

18.5.9 During each subsequent visit this information should be reviewed and any significant changes since the last survey visit recorded.

18.5.10 Where there is any uncertainty over water vole droppings found that cannot be definitively identified in the field, a small sample (considered to represent droppings from a single species) should be collected and sealed in a plastic bag marked with the following details:

- date sample collected (day/month/year);
- survey location;
- GPS coordinates;
- suspected species; and
- surveyor name.

18.5.11 The sample should be stored in a cool, dry place until the completion of the survey in that area. DNA analysis will subsequently be conducted if considered appropriate,

that is, on those dropping samples where the survey has found no other definitive evidence of the presence of water vole within the respective survey area in order to help determine presence/absence.

18.5.12 Once field sign data have been obtained, the population size of the voles in that stretch of watercourse should be calculated. This should be based on the standard recognised method for calculating the population size, namely Morris et al (1998)[54].

## 18.6 Survey programme and effort

18.6.1 During 2012 survey should ideally be undertaken between mid-April and September with at least two survey visits to each water body/watercourse undertaken, in one season. Where access consents allow, a survey should be undertaken in the early season (mid-April to June) and another in late season (July to September). Where constraints prevent this timing, attempts should be made to ensure that visits are conducted at least two months apart.

18.6.2 At sites where no visits were achieved during the period mid-April to September 2012 then where access is available a single visit during October 2012 should be conducted in an attempt to gain early confirmation of presence.

18.6.3 At sites where a single visit has already been conducted during the period mid-April to September 2012 under suitable conditions then no further visit should be conducted during October 2012.

18.6.4 During 2013 a single additional visit should be conducted during the period mid-April to mid-June at all sites where any of the following apply:

- only one or no survey visit was completed during the optimum period during 2012; or
- no survey visit was conducted in the corresponding period during 2012 (i.e. if only an autumn visit was conducted during 2012, then a spring visit should be conducted in 2013); or
- confirmed evidence of water vole was recorded during either of the survey visits during 2012 surveys.

18.6.5 Two survey visits should be conducted during the period mid-April to mid-June 2013 (at least one month apart) if no survey visits are achieved during 2012 during the optimum survey period.

18.6.6 Survey should not be conducted during or following periods of heavy rainfall, as field signs will have been washed away. In general where possible survey visits should be timed to avoid survey when water levels are high, or when management works have recently taken place.

[54] Morris, P., Morris, M., MacPhearson, D., Jefferies, D., Strachan, R., and Woodroff, G. (1998), *Estimating numbers of water voles Arvicola terrestris: a correction to the published method.* Journal of Zoology, 246, 61-62.

## 18.7 References

Morris, P., Morris, M., MacPhearson, D., Jeffries, D., Strachan, R. and Woodroff, G. (1998) Estimating numbers of the water vole *Arvicola terrestris*: a correction to the published method. Journal of Zoology. 246, 61-62.

Natural England (2008). Water voles – the law in practice. Guidance for planners and developers (NE 86). Natural England, Peterborough.

Natural England (2011). Natural England Technical Information Note TIN042; Water voles and development: licensing policy. Natural England, Peterborough.

Strachan, R., Moorhouse ,T., and Gelling, M. (2011). Water Vole Conservation Handbook – Third Edition. Wildlife Conservation Research Unit, Oxford.

IEEM (2011). Competencies for Species Surveys: Water Vole IEEM, Winchester. Downloaded at http://www.ieem.net/docs/CSS%20-%20WATER%20VOLE%20%2831.8.2011%29.pdf on 8 March 2012.

# 19 Badger

## 19.1 Introduction and guidelines

19.1.1 Potential impacts on badgers are likely to be loss of setts within the land required for the construction of the Proposed Scheme, potential for disturbance of setts in close proximity to the land required, and severance/fragmentation of territories.

19.1.2 Survey for badgers will need to identify both sett locations and, where there is the potential for significant severance/fragmentation of territories, an understanding of territory use through detailed survey, including use of bait marking studies if necessary.

19.1.3 Sett surveys are to be conducted in line with guidance provided in Harris et al (1989)[55].

## 19.2 Qualifications and experience

19.2.1 All personnel involved in scoping and defining the survey area should be experienced in assessing habitat potential for badgers, and the potential impacts of severance/fragmentation of territories.

19.2.2 All personnel conducting detailed badger survey should be competent and experienced in the identification of the full range of badger field signs including setts, latrines, hairs, badger paths and foraging signs including 'snuffle' holes. In addition they should be competent in identifying field signs of other species, such as foxes, rabbits, otters, dogs and cats.

19.2.3 All personnel conducting badger survey should be familiar with the definitions of sett type detailed by Harris et al (1989), and the classification of setts utilising this methodology in the field.

19.2.4 All bait marking surveys should be coordinated by ecologists with experience of utilising this technique.

## 19.3 Licensing requirements

19.3.1 Proposed survey methodologies will not involve either the destruction or disturbance of setts, so that no licence is required. If it is necessary to monitor activity at setts, camera traps at sett entrances should be used. Application for a licence to interfere with a badger sett (under the Protection of Badgers Act, 1992)[56] would only be required if there is a need for the use of more intrusive methods such as internal camera investigations of setts.

## 19.4 Screening for survey and defining the survey area

19.4.1 Utilising results from the Phase 1 habitat survey, desk study records and analysis of aerial photographs, consultants undertaking survey work will identify areas within the land required for the construction of the Proposed Scheme, or within a 100m surrounding buffer that are likely to be used by badgers and where there is the

[55] Harris, S., Cresswell, P., and Jefferies, D. (1989). *Surveying Badgers. Occasional publication of the Mammals Society.*
[56] Protection of Badgers Act (1992) Chapter 51. Her Majesty's Stationery Office.

potential for significant effects to occur. This assessment should take into account the following criteria:

- suitability of habitat and topography for creation of setts;
- availability of other habitat suitable for badger within close proximity to the land required for the construction of the Proposed Scheme;
- connectivity with other areas of suitable habitat; and
- potential for severance/fragmentation of territories.

19.4.2 Areas selected based on the above criteria will be subject to a detailed survey for field signs.

19.4.3 Where main or annex setts are identified within the initial survey area, there is likely to be a need to conduct further survey to establish the likely extent of territories. Such decisions on an acceptable extent of further survey should be determined by an experienced badger surveyor.

## 19.5 Survey methods

### Detailed survey for field signs

19.5.1 For all areas subject to survey, a systematic walkover will be conducted of all suitable habitats to obtain records of the following:

- setts;
- hairs;
- badger paths/runs;
- mammal paths (possible badger);
- foraging signs;
- latrines;
- footprints;
- bedding material; and
- evidence of rabbit and fox.

19.5.2 For all setts identified during the walkover survey, entrances and the orientation of entrance holes should be mapped. The sett should be classified against the criteria laid out in Harris et al (1989) as either a 'main', 'annexe', 'subsidiary' or 'outlying' sett. The level of use for each entrance should be classified as either 'active', 'partially active' or 'disused'.

19.5.3 During the walkover surveyors should also record the location and current use of any large entrances not currently utilised by badger, in order that these entrances can be monitored for future use during the period up to construction.

19.5.4 All field signs of badger, along with those of any other notable species are to be recorded with GPS-derived grid coordinates accurate to less than 5m. Where

topography and vegetation structure may have reduced the accuracy of records below this level this information should be noted.

### Territory analysis

19.5.5 Following completion of the detailed survey for field signs, results should be reviewed to identify those locations where further survey will be required in order to determine the extent of territories and thus the significance of any effects of the Proposed Scheme on the badger population.

19.5.6 The requirement for detailed survey for field signs over an extended area (i.e. beyond a 100m buffer from the land required from the construction of the Proposed Scheme) should be considered at all locations where detailed survey for field signs identifies a main or annex sett within the land required for the construction of the Proposed Scheme or within a 100m buffer of the land required.

19.5.7 The aim of such further surveys would be to better understand those territories that may be subject to significant effects as a consequence of the construction or operation of the Proposed Scheme, either through loss or disturbance of setts, loss of foraging habitat, or severance of commuting routes. It is envisaged that in the first instance this would involve extending the survey extent in the vicinity of identified main setts to determine likely territory boundaries, principally through the identification and mapping of boundary latrines. The extent of survey appropriate at each location is likely to vary and should be determined and justified by an experienced badger surveyor.

### Bait marking

19.5.8 It is likely that in some locations following survey of an extended area for field signs, it will be necessary to conduct bait marking exercises to aid in the identification of territory boundaries. Active main setts and annexes within the survey area that could be significantly affected should be selected for bait-marking studies, with each main sett being designated with a uniquely coloured plastic marker; other setts are to be included as required. On the first two days of feeding, bait should be deposited down any active holes; after this period, bait should be distributed up to a distance of 15 – 20m from active holes.

19.5.9 Once the survey is completed, the location of each latrine and the origin of the coloured return are to be charted on a map.

## 19.6 Survey programme and effort

### Survey for field signs

19.6.1 Detailed survey for field signs is to be conducted during early spring or autumn/winter, where possible.

### Bait marking

19.6.2 Bait-marking should generally be conducted during late February, March and April when territorial activity is typically at its peak.

19.6.3 Active sett entrances to be baited should be visited daily preferably in the late afternoon. Approximately 25 – 30 bait points should be applied for each main sett.

19.6.4 Bait should be laid daily for approximately two weeks. Approximately one week after commencements of baiting, daily checks should commence to identify any latrines containing bait. Latrine checks should continue for approximately seven days after the cessation of baiting. Marked droppings may contain low numbers of beads; therefore each latrine/dropping should be inspected thoroughly using a pallet knife or trowel.

## 19.7 References

Harris, S., Cresswell, P., and Jefferies, D. (1989). Surveying Badgers. Mammal Society.

IEEM (2011) Competencies for Species Surveys: Badger IEEM, Winchester. Downloaded at http://www.ieem.net/docs/CSS%20-%20BADGER%20(31.8.2011).pdf on 8 March 2012.

Protection of Badgers Act (1992) Chapter 51. Her Majesty's Stationery Office.

# 20 Invertebrates

## 20.1 Introduction and guidelines

20.1.1 The invertebrate surveys to be conducted are aimed at identifying significant effects on invertebrates as a result of the construction or operation of the Proposed Scheme. Therefore, survey design and analysis should be directed towards the aim of providing sufficient information to allow an assessment of significant effects on invertebrate species and assemblages to be made. Most of the methods described are derived from "Surveying terrestrial and freshwater invertebrates for conservation evaluation" (Natural England, NERR005 2007)[57]', but focussed upon the need to support an EIA.

20.1.2 Many invertebrate taxa are poorly understood in terms of their ecology and distribution. Although records of the presence of such species are a valuable addition to distributional knowledge, it is often not possible to accurately assess the value of a species record in a taxon which does not have a good database of distributional information. Even the first record of a species in a poorly known group does not necessarily confer significance to the site from which it was recorded without suitable contextual information. To avoid unnecessary and/or unhelpful records, the best solution is to use the recommended taxa for each habitat in the NERR005 document.

## 20.2 Qualifications and experience

20.2.1 Field surveyors should ideally be experienced entomologists but where sample collection is made for later identification, the surveyors are to be trained and/or have extensive experience in the techniques which are to be employed, including the collection, preservation and labelling of specimens. Identification should only be undertaken by experienced taxonomists. There is currently no formal competency framework and so fulfilment of at least one of the following is required:

- member/Fellow of the Royal Entomological Society;
- employed as an entomologist by a museum/local authority/conservation organisation;
- working as a professional consultant entomologist with track record in the groups under consideration; or
- having a substantial record of publications in the groups to be worked.

## 20.3 Licensing requirements

20.3.1 All surveys should follow the guidelines provided by the Joint Committee for Conservation of British Insects (2002)[58].

20.3.2 The following legal constraints are based on Natural England research report NERR005 (2007) and should be considered when conducting surveys:

- legally protected invertebrates (see the JNCC website): a license issued by the relevant statutory conservation agency is needed to collect species fully

[57] Natural England Research Report NERR005 (2007), Surveying terrestrial and freshwater invertebrates for conservation evaluation.
[58] Joint Committee for Conservation of British Insects (2002). A Code of Conduct for Collecting Insects and other Invertebrates. *British Journal of Entomology and Natural History*. 15 (1), 1-6.

protected under the Wildlife and Countryside Act. This will also cover invertebrates listed in Annex IV of the Habitats and Species Directive and for which a license is required under European regulations;

- legally protected vertebrates: it is an offence to collect or disturb protected species even as an incidental part of a lawful operation. A licence is needed if there is risk of capturing protected species (such as great crested newt) in pitfall and other passive open traps. A wire mesh placed over pitfall and water traps will reduce or prevent this risk, but may also reduce the catch of larger invertebrates;
- bye-laws and rules: capturing animals is prohibited by bye-laws and the rules of several organisations, including the Forestry Commission, Forest Enterprise, the National Trust, the Environment Agency, county wildlife trusts and local authorities (for Nature Reserves). Permission is required for surveys on sites covered by such bye-laws and rules;
- National Nature Reserves and Sites of Special Scientific Interest: collecting on these sites is classed in England as an 'operation likely to damage'. Permission to collect must be obtained from the local office of the statutory conservation agency. Permission is unlikely to be refused for a 'bona fide' survey; and
- criminal damage: under the Wildlife and Countryside Act, it is an offence to uproot a wild plant without the landowner's permission. If surveys require digging up plants, splitting branches etc. it is advisable to inform the landowner in advance.

## 20.4 Screening for survey and defining the survey area

20.4.1 The requirement for invertebrate surveys will be based on the results of the desk study, habitats identified by the Phase 1 habitat survey and their location, and are likely to be focused at survey within the land required for the construction of the Proposed Scheme and a 100m buffer either side of this.

20.4.2 A survey should be considered if the desk study provides records of protected species, species of principal importance, UK Biodiversity Action Plan species, Red Data Book species, or nationally scarce invertebrates within 2km of the route and the habitats present within the land required for the construction of the Proposed Scheme and surrounding 100m buffer either side of it are capable of:

- providing suitable breeding areas; or
- hold a significant resource for maintenance of at least one part of their life cycle (e.g. foraging habitat, overwintering habitat for eggs/larvae etc.).

20.4.3 Additionally, if the Phase 1 habitat survey identifies potentially significant habitats for invertebrates (e.g. marshy grassland, species-rich grassland, diverse woodland/scrub), then these habitats should be subject to a specific habitat assessment for invertebrate interest and the findings of this assessment used to determine whether specific sampling surveys are required.

20.4.4 Surveys of invertebrates of aquatic habitats (watercourses and standing water bodies) will be targeted to areas with records of significant species (as defined above for

terrestrial surveys) occurring anywhere in the watercourse/catchment and having similar habitat requirements as those present within the land required for the construction of the Proposed Scheme or the 100m buffer surrounding it. In respect of watercourses, additional data from the Environment Agency should be sought. In cases where an assemblage of aquatic macro-invertebrates of high ecological value (as evidenced by an above average BMWP score occurring on a regular basis within a timescale of the last 5-10 years) occurs within the same catchment/tributary as the study site, then aquatic invertebrate surveys should be undertaken.

20.4.5 It is recognised that survey areas for invertebrates will vary greatly, dependent upon the habitats considered to be of importance, and the species under consideration, for example a small area of river shingle for certain beetle species or a series of marshy grasslands for marsh fritillary metapopulation assessments. Decisions on survey area should be made by the entomologists conducting the survey, but the key focus of any survey work should be within the land required for the construction of the Proposed Scheme and a 100m buffer either side of it. Outside this zone, consultants undertaking survey works should submit a deviation request where they feel there is the requirement for additional survey to identify potential significant effects.

## 20.5 Survey methods

20.5.1 Species information from each site should be in a format suitable for input to ISIS. This is a computer application developed by Natural England. ISIS interprets species lists by recognising assemblage types within a list and scoring each type according to its conservation value. It provides a standardised, and accepted, method of evaluation across the scheme. Further details on these data requirements are presented in Natural England (2007).

### Terrestrial habitat survey

20.5.2 Where it is assessed that detailed surveys are required, then the appropriate methods relevant to the taxa and habitats under consideration are to be adopted. These methods could include but are not necessarily limited to:

- sweep netting - standardised through timed netting in appropriate habitats, if required;
- hand searches of specific host plants (for leaf mines, galls) of particular species;
- egg searches (e.g. black hairstreak);
- conspicuous aggregations (e.g. marsh fritillary 'webs');
- pitfall trapping;
- white tray trapping;
- suction sampling; and
- light trapping.

20.5.3 Methods selected are to be as species specific and/or focussed as possible on habitats of actual or potential importance. Natural England (2007) provides details of standard

methodologies, and the selection of appropriate methods in terms of habitats and taxa. The methods adopted should follow this guidance wherever possible. Methods such as light trapping, which attract specimens from a large distance, should be used with caution.

20.5.4 In addition, general butterfly surveys will be required in identified suitable habitats and include brownfield sites in urban areas where species such as grizzled and/or dingy skipper are known or suspected.

20.5.5 Generally, the surveys for butterflies are to be based upon the establishment of transect walks that are surveyed a minimum of three times (May, June, July) recording species at an appropriate time (10.00-16.00) and during suitable weather conditions (temperatures not below 13°C and 13-17°C only if at least 60% sunshine; clear or light cloud; still or light wind (less than Beaufort Scale 5); no rain).

## Aquatic invertebrates

20.5.6 Rivers and streams are to be sampled according to the published methodology applicable to the size of the watercourse (e.g. 3-minute kick sampling, surber sampling) and specimens identified to species level or the lowest possible taxonomic unit and counted. Measurements of the environmental variables required for input into RIVPACS are also to be taken and then the data set(s) analysed using the RIVPACS program, if this is considered necessary to predict likely significant effects.

20.5.7 Surveys of ditches selected (see Section 9) are to follow the published methodology in "A Manual for the Survey and Evaluation of the Aquatic Plant and Invertebrate Assemblages of Grazing Marsh Ditch Systems" Version 6 May 2013 Buglife – The Invertebrate Conservation Trust[59].

20.5.8 It is acknowledged that the above methodologies were devised for use in a programme of survey and evaluation work relating to the ditches associated with grazing marshes. However, the general survey strategy is considered to remain valid and the evaluation procedures outlined within the manual will be modified so that they are appropriate. A modified version of the evaluation criteria appropriate to the ditch types surveyed are to be utilised.

20.5.9 Surveys of ponds (see Section 10 for selection process) are to follow one of the methods in the National Pond Monitoring Network (http://www.pondconservation.org.uk/about/Areas+of+Expertise/nationalpondmonitoringnetwork)[60]:

- the rapid assessment for ponds requires invertebrate sampling only and is a rapid assessment of 'naturalness' using invertebrate diversity and families similar to the Biological Monitoring Working Party system for running water;
- the Predictive SYstem for Multimetrics (PSYM) method includes collection of physical data, invertebrate sampling and plant recording. These data are used to undertake an analysis to compare the pond against a national database held

[59] Palmer, M., Drake, M., Stewart, N. (2013). A *manual for the survey and evaluation of the aquatic plant and invertebrate assemblages of grazing marsh ditch systems. Version 6*. Buglife.
[60] National Pond Monitoring Network (2013). *Pond conservation*. Available at http://www.pondconservation.org.uk/about/Areas+of+Expertise/nationalpondmonitoringnetwork . Accessed 01 October 2013.

by the Pond Conservation Trust (PCT). The data are submitted to the PCT for analysis; and

- The National Pond Survey method provides a more detailed assessment of a pond and includes environmental and chemical data from the pond in addition to plant and invertebrate survey and ideally requires sampling of the invertebrate fauna over three seasons.

20.5.10 The method used will depend on the location of the pond (e.g. within the land required for the construction of the Proposed Scheme, or outside of it) and the potential impact upon it.

## 20.6 Survey programme and effort

20.6.1 The number and timing of visits will be dependent on the habitats to be surveyed, and the taxa under consideration. The guidance and advice presented in Natural England (2007) should be used on a case by case basis. Typically, where surveys are required, three sample sessions spaced out between May and September are likely to be appropriate for terrestrial habitats; two visits (spring and autumn) for aquatic habitats.

## 20.7 References

Joint Committee for Conservation of British Insects (2002). A Code of Conduct for Collecting Insects and Other Invertebrates. British Journal of Entomology and Natural History 15(1), 1-6.

Natural England Research Report NERR005 (2007). Surveying terrestrial and freshwater invertebrates for conservation evaluation

National Pond Monitoring Network (2013). Pond Conservation. Available at http://www.pondconservation.org.uk/about/Areas+of+Expertise/nationalpondmonitoringnetwork. Accessed 1 October 2013.

Palmer, M., Drake, M., Stewart, N. (2013). A manual for the survey and evaluation of the aquatic plant and invertebrate assemblages of grazing marsh ditch systems. Version 6. Buglife.

# 21 White-clawed crayfish

## 21.1 Introduction and guidelines

21.1.1 Where white-clawed crayfish may be present and significant effects could occur, then survey is likely to be required. The scope of survey required is defined in Peay (2004)[61] and is set out below.

## 21.2 Qualifications and experience

21.2.1 The competency standards for white-clawed crayfish have been issued by the Chartered Institute for Ecology and Environmental Management[62] and at least one surveyor should meet or exceed those minimum standards and have held and used a survey licence for white-clawed crayfish survey for at least one year. The licence holder will ensure that any assistants have had sufficient training in biosecurity, crayfish habitat appraisal and survey practice to carry out work properly and that they are supervised as appropriate.

## 21.3 Licensing requirements

21.3.1 The ecologist responsible for the crayfish surveys must hold a protected species survey licence from Natural England for surveys at locations with the potential for white-clawed crayfish. In addition, consent for trapping and manual searching will be required from the Environment Agency Fish Movement Team at Brampton.

## 21.4 Screening for survey and defining the survey area

21.4.1 The relevant scale for distribution data on white-clawed crayfish is the sub-catchment. Most data are held by the Environment Agency in the Area offices. Desk studies should search for records for white-clawed crayfish, signal crayfish and other non-native crayfish species. The best composite database was compiled for a Defra project and includes a classification of sub-catchments (Rogers and Watson, 2011)[63].

21.4.2 Surveys for white-clawed crayfish can be screened out when any of the following apply:

- best available information indicates there are no white-clawed crayfish remaining in the sub-catchment (although allowance should be made for the possibility of small relict populations in headwater streams if the species has been lost from the main river, if there have not been any recent surveys to check status);
- the watercourse within the land required for the construction of the Proposed Scheme and adjoining 100m buffer either side is dry during any period of the year;

[61] Peay, S. (2004), A cost-led evaluation of survey methods and monitoring for white-clawed crayfish – lesson from the UK. Bulletin Français de la Pêche et de la Pisciculture 372-373, 335-352. Available to download from the national crayfish website (hosted by Buglife, www.crayfish.org.uk and from free access journal BFPP, now Knowledge and Management of Aquatic Ecosystems).
[62] CIEEM (2013), Technical Guidance Series. Competencies for Species Survey: White-clawed Crayfish. CIWEEM, Winchester. April 2013.
[63] Rogers, D. and Watson, E. (2011). Distribution database for crayfish in England and Wales. In: Rees M, Nightingale J, Holdich (eds) Species survival: securing white-clawed crayfish in a changing environment. Proceedings of a conference held on 16 and 17th November 2010 in Bristol, UK. Available to download from the national crayfish website (hosted by Buglife, www.crayfish.org.uk )

- there are confirmed records of non-native crayfish within 1km of the land required for the construction of the Proposed Scheme as measured along a watercourse (note this can include records of non-native crayfish in angling ponds and fish farms where there is an inflow or outflow that offers a potential route for escape, i.e. from almost all sites with non-native crayfish) and other surveys indicate that there have been no white-clawed crayfish present within the past 5 years in the study area;
- there are records of non-native crayfish up to 5 km from the land required for construction of the Proposed Scheme, both upstream and downstream on the same watercourse and there are grounds to expect that there is a continuous population of non-native crayfish between them. Any tributary of a known invaded watercourse should be surveyed unless there are grounds to expect the tributary has been invaded as far as the land required for the construction of the Proposed Scheme and beyond it for a period of 5 years or more;
- water quality is poor (GQA D or less, or WFD equivalent) currently;
- water quality has been poor (GQA D or less, or WFD equivalent) within the past 10 years and there are no populations of white-clawed crayfish in connected tributaries within 2km;
- water chemistry is unsuitable due to mean pH6.5 or less and/or calcium less than $5mgl^{-1}$;
- extended Phase 1 habitat survey and/or River Corridor Survey shows that there is no potentially suitable habitat for white-clawed crayfish (e.g. channel is a highly modified open culvert with walls of mortared stone, intact brick or sheet piling, and a channel bed which also has no refuge potential for crayfish; note however that banks of unmortared stone revetment and damaged brick or concrete can be very favourable habitat, even if there is only small substrate such as sand or gravel);
- there has been an incident of crayfish plague within the past five years and there is no known or potential surviving relict population in the watercourse or connected tributaries within 2km; and/or
- specific surveys for crayfish have been carried out within the past three years in the watercourse at more than one site, at least one of which is within 2km of the land required for the construction of the Proposed Scheme, and no crayfish have been found.

21.4.3 The requirement to survey static water bodies such as farm ponds, quarries and other wholly enclosed still water sites should be considered, taking into account the location, permanence, water quality, degree of isolation from other water bodies, and desk study data for white-clawed and non-native crayfish species in the local area. Where such water bodies are considered potentially suitable to support white-clawed crayfish (including where sites may have been suitable to be utilised as an Ark site[64])

[64] One approach to conserving the white-clawed crayfish is to establish isolated new refuge sites, known as 'Ark sites', where new populations can be established, safe from non-native crayfish and crayfish plague.

and full survey is considered to be required the consultant undertaking surveys should submit a deviation request. For all static water bodies scoped out a rationale for this decision should be recorded making reference to the criteria listed above.

21.4.4 Records of white-clawed crayfish within the past ten years are of potential value, but even populations surveyed within the past two years are not necessarily present. By contrast, all validated records of signal crayfish or other non-native crayfish should be assumed to be still present and more extensive than they were when last recorded.

21.4.5 Watercourses or other water bodies that lie within the land required for the construction of the Proposed Scheme and surrounding 100m buffer either side of it and have not been screened out (as described above) should be surveyed if there is potential for significant effects. Where habitat suitable for survey is limited within this zone, but there is potentially favourable habitat beyond, the survey area should be extended out, up to a 250m buffer from the land required for the construction of the Proposed Scheme. Depending upon predicted impacts, there may be a need to survey more than one site on the watercourse. Selection of reaches to survey should use the approach in Peay (2003)[65].

21.4.6 If there are difficulties in obtaining permission to survey some areas, the location of the survey site can be shifted upstream or downstream in a reach; provided at least part of the site is within 500m of the land required for the construction of the Proposed Scheme and there are no differences in water quality, the habitat is similar and there are no barriers that might affect the distribution of crayfish (e.g. a weir might have been enough to stop an outbreak of crayfish plague infecting the population upstream).

## 21.5 Survey methods

21.5.1 The survey method(s) used are to be the most appropriate for the type of habitat present (see Peay, 2004). The potential habitat for crayfish and the scope for using different survey methods should ideally be assessed in advance, e.g. as part of extended Phase 1 habitat survey.

21.5.2 Survey sites will be a minimum of 100m (where there is abundant manually searchable habitat of good quality); generally up to 200m for most small watercourses; or up to a maximum of 400m where suitable areas for survey are localised or widely dispersed, e.g. in large watercourses.

21.5.3 A site-scale habitat appraisal for crayfish is to be carried out. This includes a description plus site photographs, but in addition, any water body surveyed within the land required for the construction of the Proposed Scheme should be mapped in the style of a River Corridor Survey with annotation of features relevant to crayfish habitat quality, e.g. pool under bridge with many cobble-sized stones and cracked mortar below water; alder trees with dense swags of submerged roots, sewage fungus downstream of pipe discharge along right bank, etc.

21.5.4 Particular attention is to be given to whether conditions will be suitable for manual survey, i.e. there must be ample loose, 'searchable' potential refuges in shallow water less than 0.5m deep in water that is clear, with little settled silt and with extensive

[65] Peay, S. (2003). *Monitoring the White-Clawed Crayfish Austropotamobius pallipes. Conserving Natura 2000 Rivers. Monitoring Series No. 1.* English Nature, Peterborough.

lengths (greater than 100m) that can be safely accessed from the bank and waded. Where these conditions are not met, some searching of debris and undercut banks by kicking and netting is to be undertaken where possible. If netting is not feasible, or does not yield crayfish, then trapping is required. If crayfish are identified by manual survey or netting, or by other signs of crayfish, e.g. exuvia, claws etc., it is not necessary to carry out trapping as well.

21.5.5 All crayfish surveys are to be carried out in dry weather and normal to low flow. If there is any rainfall overnight during a trapping survey the survey is invalid if rain falls within four hours of sunset.

21.5.6 Biosecurity measures are to be implemented throughout, with disinfection (iodine based disinfectant) of all equipment between water bodies (see Environment Agency guidance at www.environment-agency.co.uk/homeandleisure/recreation/fishing/38053.aspx). Where more than one site is surveyed on a watercourse, surveys will be carried out at upstream sites first. If a downstream site is surveyed first, there will be disinfection between sites. As far as practicable, traps are to be placed where they are least likely to be seen or tampered with, to minimize the risk of losses or subsequent use for illegal trapping. Signal crayfish should not be released back to the wild.

21.5.7 Where there is a relatively abundant population of crayfish and plenty of stony habitat to search, a standardised manual survey of five habitat patches of ten good refuges gives a high probability of detecting crayfish. However, where populations are at low abundance and conditions are sub-optimal for manual search, the chances of detecting a crayfish with this level of effort are less. Furthermore, as the method described in Peay (2003) includes searching cobbles and pebbles under large cobble and boulder as one refuge, the actual number of stones searched in a standardised survey may be 2-3 times higher. Where status of crayfish is unknown, survey effort is to be double the minimum, preferably with more patches searched rather than just more refuges in one area.

21.5.8 Trapping surveys are to target the areas with the highest potential for crayfish, avoiding any areas with fast flow or anoxic silt. Traps need not be wholly immersed, but trap apertures must be entirely below water level throughout the trapping session. Traps should be sited to avoid overlap of trapping zone. Traps will be left for one night only and will be lifted the next morning. Trap mesh size should ideally be less than 22mm.

21.5.9 One or more digital photographs are to be taken to confirm the species of crayfish recorded. Photographs should be taken such that the diagnostic features are clearly visible. If there is any doubt about identification, reference specimens should be taken and preserved. This may be necessary with juvenile crayfish especially with the less common non-native species, such as *Orconectes virilis cf O. limosus*. Preservation uses 90% ethanol solution, preferably with 10% formalin to fix. Alcohol will need to be changed/topped up, especially if large specimens are preserved.

21.5.10 Where signal crayfish are recorded during a survey then that survey session at the location should be completed in full. However, assuming that no white–clawed crayfish are found then no repeat survey sessions should be conducted at that site. If there are other sites to be surveyed in the same watercourse, they should still be surveyed if records or other information suggests that it is likely white-clawed crayfish

were present within the past five years. This is to help find any semi-isolated relict populations of white-clawed crayfish.

## 21.6 Survey programme and effort

21.6.1 All surveys should ideally be carried out in good conditions in the period July to September inclusive. Whilst intensive manual surveys on sites with high densities of crayfish may detect presence at most times of year, nil catches outside the main season of activity are invalid. All surveys conducted outside the July to September period should acknowledge that negative results are not suitable to confirm absence.

21.6.2 Manual surveys will use standardised manual survey, extended to double effort where conditions are suitable and crayfish are not detected in the first session. Where there is enough habitat to carry out a manual survey, but 'survey ability' is less than expected and there is potentially good habitat in the banks, a trapping session should be added.

21.6.3 At sites where trapping is carried out, a survey will use a minimum of 20 traps per site in favourable habitat. If crayfish are not detected, a second session should be carried out at least one week after first session (provided it is within the survey season).

21.6.4 Stages of work on site are as follows:

- walkover of the survey site for prior assessment of potential for crayfish habitat at site scale and safety check;
- carry out manual survey if suitable habitat is available and suitable for survey. Complete five patch standardised survey, with supplement by netting if necessary;
- if crayfish are not found, extend the manual survey extent and coverage to double session;
- if crayfish are not found, or if conditions are not suitable for manual survey, set minimum 20 traps in best habitat;
- if crayfish not found, repeat trapping session after one week or more; and then
- if crayfish are not found, conclude that they are likely to be absent.

## 21.7 References

Rogers, D. and Watson, E. (2011). Distribution database for crayfish in England and Wales. In: Rees M, Nightingale J, Holdich (eds) Species survival: securing white-clawed crayfish in a changing environment. Proceedings of a conference held on 16 and 17th November 2010 in Bristol, UK. Available to download from the national crayfish website (hosted by Buglife, www.crayfish.org.uk ).

Peay, S. (2003). Monitoring the White-clawed Crayfish *Austropotamobius pallipes*. Conserving Natura 2000 Rivers. Monitoring Series No. 1. English Nature, Peterborough.

Peay, S. (2004). A cost-led evaluation of survey methods and monitoring for white-clawed crayfish – lessons from the UK. Bulletin Français de la Pêche et de la

Pisciculture 372-373, 335-352. Available to download from the national crayfish website (hosted by Buglife, www.crayfish.org.uk and from free access journal BFPP, now Knowledge and Management of Aquatic Ecosystems).

The following website will also be useful for information on crayfish distribution etc.: http://www.buglife.org.uk/conservation/currentprojects/Species+Action/UK+Crayfish+Website

# 22 Fish

## 22.1 Introduction and guidelines

22.1.1 The requirements for fish survey are to be assessed following a review of existing data, and where possible an initial habitat assessment. Following the review of existing data, the consultants responsible for survey work will agree with the local Environment Agency team the most appropriate scope and method of survey on a location by location basis for assessing the potential for significant impacts on fish.

## 22.2 Qualifications and experience

22.2.1 Surveyors are to be appropriately experienced in fish habitat assessment and survey.

## 22.3 Licensing requirements

22.3.1 No licences are required for the initial habitat assessment.

22.3.2 Relevant consents from the Environment Agency are to be obtained prior to commencement of any further fish surveys such as electrofishing.

## 22.4 Screening for survey and defining the survey area

22.4.1 Requirements for fish surveys are likely to be strongly influenced by the availability and quality of fisheries data from the Environment Agency (EA). Where insufficient data exist to assess likely effects, surveys are more likely to be required for water bodies meeting one or more of the following criteria:

- water bodies designated under the EC Freshwater Fish Directive (2006/44/EC);
- water bodies designated as Special Areas of Conservation or Site of Special Scientific Interest (SSSIs) for fish species or their water habitat; and/or
- water bodies likely to host protected fish species/fish species of conservation concern.

22.4.2 Water bodies affected by the route should be categorised for fish habitat quality and the potential for utilisation by fish. Surveys may be necessary for moderate and good habitats that could be directly or indirectly affected by the proposals where no existing recent data are held by the Environment Agency. Further surveys are unlikely to be required for poor habitats.

22.4.3 Typical descriptors for good, moderate and poor quality habitats are as follows:

- good: For running waters the habitats include varying flow types to include rifles pools, runs, and glides. Substrate diversity is more complex and there is good cover to provide refuge for juvenile and adult fish (both in-stream/body and marginal vegetation). Substrate is present for spawning salmonids. No evidence of pollution or other degradation. No obvious barriers to migration (where applicable to species concerned);
- moderate: For running waters the habitats include a number of flow types throughout the survey reach. Limited substrate diversity. Sparse cover for

both juvenile and adult fish. Lower in-stream/body and marginal vegetation diversity. Limited substrate present for spawning salmonids. No evidence of pollution; other degradation (e.g. poaching) may be present. Potential barriers to upstream migration present (where applicable to species concerned); and

- poor: Habitats with minimal variation. Substrate diversity limited. No bankside/marginal cover for fish. In-stream and marginal vegetation (where present) typically limited to single dominating species. No substrate available for spawning salmonids. Water body may receive diffuse, land-based pollution (run-off) and exhibit a high degree of other degradation such as poaching. Barriers to upstream migration (debris/man-made dams) present (where applicable to species concerned).

22.4.4 The consultants undertaking survey work should recommend the survey area on a site by site basis depending on habitat quality, upstream and downstream characteristics and likely effects on fish. Where access and seasonal constraints dictate it may be necessary for fish habitat assessments to be undertaken in parallel with detailed survey work.

## 22.5 Survey method

22.5.1 As most affected water bodies requiring survey are likely to be small the primary method is likely to be electrofishing (utilising stop nets where necessary). This should be undertaken in accordance with British Standard BS EN 14011:2003, BS 6068-5.32:2003 'Water Quality: Sampling of fish with electricity'[66] and 'Guidelines for Electric Fishing Best Practice (Beaumont et al., 2002)[67] published by the Environment Agency. It is likely that a single pass of approximately 100m$^2$ will be sufficient.

22.5.2 If fish survey is necessary and conditions are not suitable for electrofishing then a seine-netting sweep is likely to be employed. Detailed survey methods used will dependent on the watercourse characteristics and will be agreed with the local Environment Agency team.

## 22.6 Survey programme and effort

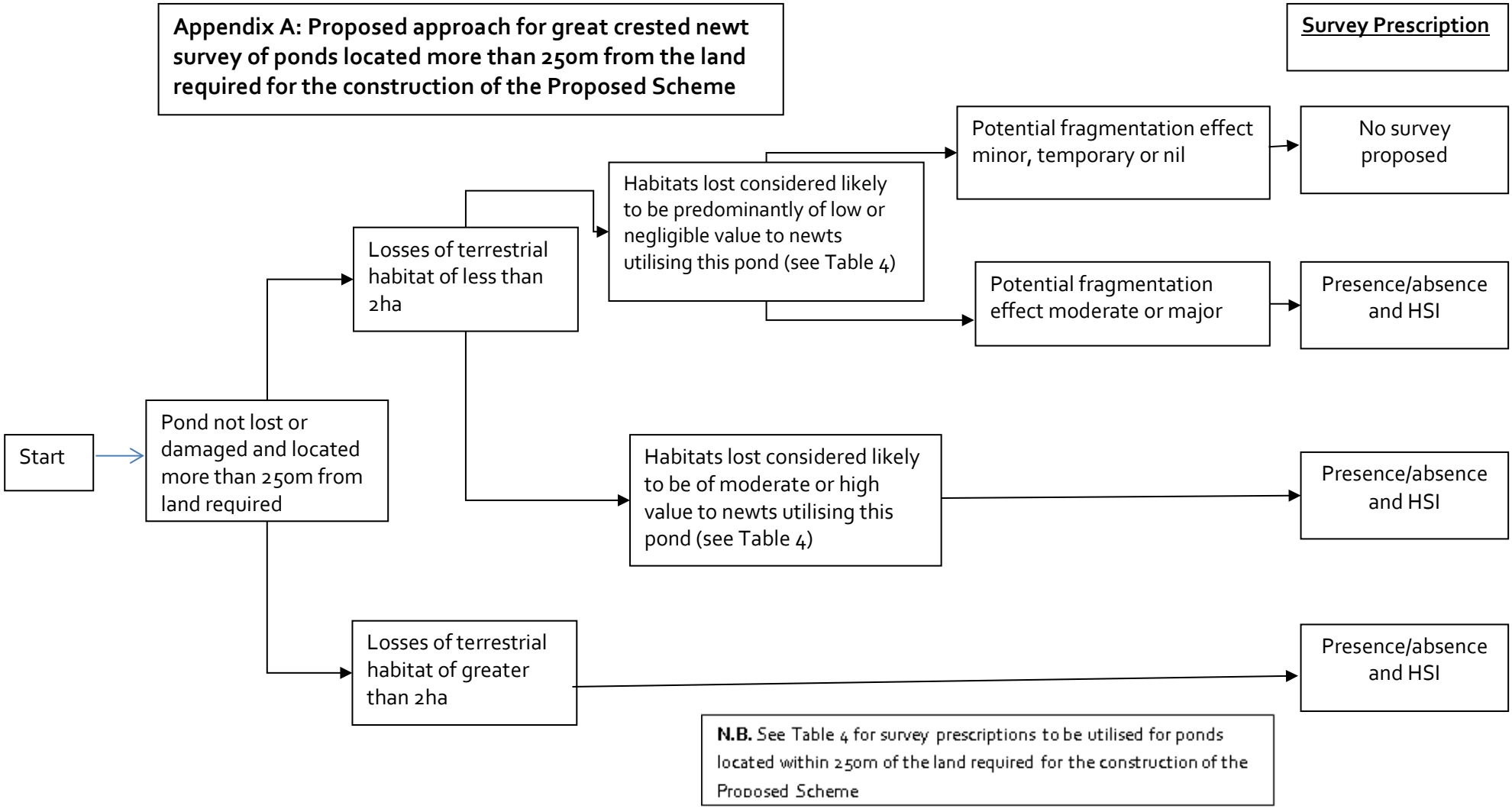
22.6.1 Survey programme and effort are to be confirmed following discussion with local Environment Agency teams.

## 22.7 References

Beaumont, W.R.C., Taylor, A.A.L., Lee, M.J., Welton, J.S. (2002). Guidelines for Electric Fishing Best Practice. RandD Technical Report W2 – 054/TR. Environment Agency, Almondsbury.

[66] British Standard BS EN 14011:2003, BS 6068-5.32:2003 'Water Quality: Sampling of fish with electricity'.
[67] Beaumont, W.R.C., Taylor, A.A.L., Lee, M.J., Welton, J.S. (2002). *Guidelines for Electric Fishing Best Practice. RandD Technical Report W2 – 054/TR.* Environment Agency, Almondsbury.

# Appendix A: Great crested newt survey decision flowchart



# Appendix B: Use of non-standard survey methods to provide early warning of the presence of great crested newt

## B.1 Introduction

1.1.1 Where it has not been possible to complete amphibian survey of a water body during the mid-March 2012 to mid-June 2012 survey window, efforts will be taken to provide early warning of potential presence of great crested newt through late season surveys.

1.1.2 Consultants undertaking surveys should submit their proposals to overseeing consultants for approval where non-standard survey methods can be employed to gain further information prior to the mid-March 2013 to mid-June 2013 survey window. It is unlikely that use of non-standard survey methods will be justifiable at all water bodies. Consultants undertaking surveys should consider the likely potential for significant impacts on any populations that are present and/or for significant mitigation requirements, based on the current assumed land required for the construction of the Proposed Scheme.

### Survey method

1.1.3 For each pond identified as being suitable for late amphibian survey a single night time visit should be conducted during September 2012 to conduct survey utilising the following methods:

- netting for larvae – netting would utilise a 2-4mm long handled dip net and be conducted during day or night. A single perimeter walk would be conducted with at least 15 minutes of netting conducted per 50m of shoreline; and
- torching – a single torchlight survey during September 2012.

1.1.4 Survey may be conducted on any nights where air temperature is 5°C or above at point of survey until the end of September 2012.

1.1.5 It is likely that at some water bodies, the use of one of the above methods may be unsuitable as a consequence of site specific constraints. In all such cases a record should be made of the rationale for excluding a particular method.

1.1.6 Late season survey will only be utilised to provide early warning of potential amphibian constraints, and to identify those areas where further mitigation effort may be required.

1.1.7 Where access is available, all water bodies where standard pond survey was not completed (or commenced) during 2012 will be subject to full presence/absence or population size class assessment (as appropriate) during the period mid-March to mid-June 2013.

# Appendix C: Methodology for car based bat transect surveys

## C.1 Screening for survey and defining the survey area

1.1.1 Where there are significant restrictions on access, consultants undertaking survey should consider the use of car based transects to provide some baseline information on bat assemblages within these areas. As the methodology will involve driving at slow speed the use of the methodology must be limited to local roads (i.e. excluding motorways, dual carriageways and A roads), and in all cases it will be necessary to submit a detailed risk assessment for the approval of the HS2 Health and Safety Department. It will be the responsibility of the consultant undertaking survey works to notify the appropriate authorities (e.g. local Highways Authority and local police[68]) prior to commencing the survey.

### Method

1.1.2 All surveys will require a minimum of two surveyors. One of which will be exclusively driving and have no involvement in the operating of bat survey equipment.

1.1.3 Car transect routes should be planned using aerial photographs and should focus on local roads passing through the land required for the construction of the Proposed Scheme and a 100m buffer either side. Where appropriate features of particular bat interest within 500m of the land required for the construction of the Proposed Scheme were identified during scoping these should also be included. Where possible the transect route should incorporate stopping points (three minutes per stop) in close proximity to the land required and at other features of potential bat interest. A day time drive through of the proposed survey route should always be conducted prior to the first survey visit in order to identify suitable safe stopping points. The risk assessment will be reviewed and updated after the day time drive through.

1.1.4 All car transect surveys should commence at 45 minutes after sunset and continue for at least two hours. The length of each car transect should be planned to ensure that at least two passes of the entire transect route can be completed during each survey visit. In order to maximise recording within close proximity to the land required, the transect route may be not continuous.

1.1.5 Car based surveys should be conducted using a GPS enabled EM3 or SM2BAT+ detector recording in full spectrum mode. The microphone should be held within a car mount or clamp at window level at a 45 degree angle on the passenger's side or, where the microphone can be attached (as for the SM2BAT+) to a cable, it may be securely taped to the vehicle at window level.

1.1.6 Sections of the transect route subject to survey should be driven at a steady speed of 15mph (24km/h) utilising a vehicle mounted with flashing orange double beacon, reflective chevrons and a reflective sign stating 'Surveying'.

[68] Where appropriate the police should be contacted via non-emergency number to log details of the route and gain an incident number.

## Summary of survey programme and effort

1.1.7 Each car based transect route should be subject to a total of two dusk surveys per month during September and October 2012 and April, May and June 2013. The starting point and direction of the transect route should be varied between survey visits.

1.1.8 Where habitat quality is high, or the presence of Annex II species is suspected, consideration should be given to the requirement to undertake additional visits each month.

# Appendix D: Criteria for potential otter holt locations and determining usage

## D.1 Description of criteria

1.1.1 The following criteria devised by Paul Chanin (unpublished) should be utilised to identify potential holt locations and determine when they are considered likely to be potentially active.

1.1.2 Features meeting the following criteria should be identified during surveys as 'potential holts':

- tunnel with internal diameter of at least 250mm and extending 1m into the bank or where the end is out of sight; or
- any cavity of similar dimensions: drain pipe; log pile; rock/boulder pile; under structures such as bridges or buildings etc.

1.1.3 Where any of the following signs are found at features meeting the potential holt criteria they should be considered potentially active:

- presence of otter spraints or footprints beside or inside tunnel;
- evidence of an animal's body rubbing against wall or roots;
- presence of hairs ca 25mm long and mid brown in colour; or
- presence of scratch marks.

# Appendix E: Criteria for assessing potential otter breeding sites

## E.1 Description of criteria

1.1.1 The following criteria devised by Paul Chanin (unpublished) should be used in assessing the potential for habitats in the vicinity of the route to support otter breeding sites.

Table E1: Cover

| | |
|---|---|
| High | Dense impenetrable cover over more than 50% of the area, immediately adjacent to the river bank; or<br>Presence of features with potential to conceal a breeding den such as fallen hollow trees, very large trees with spreading roots on river bank, small dense thickets of impenetrable vegetation, piles of boulders or other debris with space for a den beneath which are immediately adjacent to a waterway or connect to it by concealing routes. |
| Medium | Dense impenetrable cover over 20-50% of the area, immediately adjacent to the river bank orr dense impenetrable cover over less than 50% of the area within 50m of the river with concealing routes between the bank and the area of dense cover; or<br>Presence of features with potential to conceal a breeding den such as fallen hollow trees, small dense thickets of impenetrable vegetation, piles of boulders or other debris which are not adjacent to a waterway or connected to it by concealing routes. |
| Low | Dense impenetrable cover over less than 20% of the area. No features with potential to conceal a breeding den. |
| None | No dense impenetrable cover |

Table E2: Food supply

| | |
|---|---|
| High | Within 500m of high quality food supply (pond/lake of at least 1ha or river with depth greater than 0.5m and width greater than 5m). |
| Moderate | High quality food supply within 2km; or<br>Within 500m of moderate food supply: (pond/lake of at least 0.5ha or productive river with depth greater thano.3m and width greater than 3m). |
| Low | High quality food supply > 2km away; or<br>Moderate quality food supply > 500m away. |

# HS2 London-West Midlands

# Ecology

# Technical note – Ecological assessment method

## A report to HS2 Ltd by Arup/URS

# Contents

**List of tables**



**List of appendix tables**

# 1 Introduction

## 1.1 Purpose of the technical note

1.1.1 This technical note sets out the methodology used in assessing the ecological effects of the Proposed Scheme (the Ecological Impact Assessment) within the Environmental Statement (ES) for HS2 London-West Midlands (LWM).

1.1.2 The technical note expands upon the information previously provided in the ecology sections of the HS2 LWM EIA scope and methodology report (SMR)[1] and SMR addendum[2] which are included as Volume 5 Appendix CT-001-000/1 and CT-001-000/2.

## 1.2 Purpose of Ecological Impact Assessment

1.2.1 As part of the Environmental Impact Assessment process, the purpose of the Ecological Impact Assessment (EcIA) methodology is 'to provide decision-makers with clear and concise information about the likely significant ecological effects associated with a project'.

1.2.2 It is also important that all other interested parties, including members of the public, are able to understand:

- the findings of the assessment;
- the process by which the assessment was undertaken; and
- the actions required to deliver the mitigation and compensation designed to ensure an appropriate biodiversity outcome.

1.2.3 This methodology has therefore been designed with the aim of providing a clear and transparent assessment of the ecological effects of the Proposed Scheme to all readers.

## 1.3 Other relevant guidance

1.3.1 The impact assessment methodology incorporates the key principles of the standard method for ecology as set out by the Institute of Ecology and Environmental Management (IEEM) in their Guidelines for Ecological Impact Assessment (2006)[3] – hereafter referred to as the 'IEEM guidelines'.

## 1.4 Structure of the report

1.4.1 This technical note provides information on evaluating ecological resources and receptors in Section 2; on predicting impacts of the Proposed Scheme in Section 3 and on defining and assessing the significance of the resulting ecological effects in Section 4. Section 5 introduces the approach to recording mitigation, compensation and enhancement within the assessment and Section 6 provides information on the consideration of residual effects.

[1] Arup/URS (2012), *HS2 London to West Midlands scope and methodology report.*
[2] Arup/URS (2013), *HS2 London to West Midlands: scope and methodology report addendum.*
[3] Institute of Ecology and Environmental Management (2006), *Guidelines for Ecological Impact Assessment in the United Kingdom*. IEEM, Winchester.

1.4.2 This note does not address the earlier stages of EcIA, notably definition of the scope of the assessment, as this is covered in other documents such as the SMR and SMR Addendum.

# 2 Determining value of ecological resources

## 2.1 Introduction

2.1.1 This section provides guidance on how to assign value to ecological resources. As acknowledged in the IEEM guidelines, defining the value of ecological resources does not follow a simple mechanistic approach but rather derives from professional judgement based on available guidance and information, along with supporting expert opinion. Nonetheless, it is recognised that on this project (given its scale and the number of survey teams involved), guidance is required in order to ensure a consistency of approach.

2.1.2 Ecologists undertaking the assessment should use their knowledge of the local context of the sites, species and habitats they are evaluating in determining the value of ecological resources. Internal discussion between ecological teams about the evaluation of receptors will be encouraged to maximise consistency in evaluation.

2.1.3 In determining the value of ecological resources, the IEEM approach should be adopted, whereby the social and economic values of ecological resources are considered separately from the 'ecological' value, and the significance of any social and economic effects is (where applicable) defined and reported within the Community and Socio-economics sections of the ES.

## 2.2 Evaluation: scale and reporting

2.2.1 A common difficulty in undertaking EcIA for large-scale or linear projects is the need to define a scale at which the baseline evaluation is undertaken or reported, i.e. what constitutes an individual 'receptor'. This is particularly the case where there is a wealth of baseline data which relate to different or overlapping sampling areas.

2.2.2 For a small development site, it is easy to define and present the ecological resources considered within the EcIA. Essentially, the development site is evaluated according to:

- any designations;
- other habitats within the site; and
- other species within the site.

2.2.3 Effects are then identified for each of the features (habitats and species) present. However, the geographic boundaries of the site which forms the basis of the assessment do not have any ecological validity – they are defined by the development proposal.

2.2.4 The conclusions of the HS2 EcIA will be reported in the ES within 26 separate reports (Volume 2 of the ES), which sub-divide the route and report effects based on Community Forum Area (CFA) boundaries. The cumulative effects on ecological receptors at the route-wide level (i.e. those effects above and beyond those reported within the CFA reports) will be considered in Volume 3 of the ES.

2.2.5 Within each CFA, there will be many individual features of ecological significance identified. These will include:

- designated sites;
- areas of semi-natural habitat; and
- areas of habitat or other features supporting notable species.

2.2.6 The designated sites will be evaluated based on the level of nature conservation value assigned through designation. Impacts and any resulting effects on designated sites will be assessed taking into consideration the combination of habitats and/or species which are identified as reasons for designation.

2.2.7 Whilst the CFA boundaries will be used to sub-divide the ES, the evaluation process, including decisions on an appropriate scale to provide evaluation of receptors, will not be defined by their extent.

2.2.8 For the habitats, species and other features of interest professional judgement will be used to identify the most ecologically meaningful scale to evaluate the resources/receptors present.

2.2.9 In the vast majority of situations evaluation of resources/receptors should be conducted according to one of the two approaches listed below:

a. the areas of habitat and other features could be evaluated individually (i.e. a discrete block of a particular habitat type, or the population of great crested newt supported by a single pond); or

b. grouping blocks of similar habitat, or areas supporting protected species on the basis of sound ecological reasoning (e.g. evaluating blocks of habitat of similar nature that occur in close proximity either side of a CFA boundary as a single receptor; or evaluating the great crested newt population of a series of ponds together when it is clear that these are likely to function as a metapopulation).

2.2.10 Evaluation at the CFA level may be appropriate for some widespread resources/receptors. However, this should be the exception and should not be the default approach.

## 2.3 General principles of evaluation

2.3.1 Evaluation of all potential ecological receptors should be conducted against the following frames of geographic reference:

- international;
- national;
- regional;
- county/metropolitan;
- district/borough;
- local/parish; and

- negligible.

2.3.2 The above represent a minor variation to those identified within the IEEM guidelines. The frames of reference 'within zone of influence' and 'site' have been omitted for the purposes of this assessment due to potential confusion associated with the use of these terms in relation to a linear scheme on a large scale.

2.3.3 In line with the principles laid out within the IEEM guidelines it is not considered possible to rigidly assign habitats or species to a specific level of value, as the value of the receptor may vary depending on where on the route it occurs. Evaluation should be based on available information and guidance, including published criteria where available and professional judgement. Appendix A seeks to provide an outline framework for the evaluation of receptors.

2.3.4 In line with the IEEM guidelines for valuing resources, a clear rationale for the valuation reached should be presented in all cases.

## 2.4 Designated sites

2.4.1 For formally designated sites the valuation afforded should be based on the value prescribed by the designating body. Where a feature has value at more than one level, its overriding value is that of the highest level. Where sites overlap and the features for which the site has been designated at each level differ these should be valued and assessed accordingly.

2.4.2 Potential Sites of Special Scientific Interest (pSSSI), candidate Special Areas for Conservation (cSAC)[4], proposed Special Areas of Conservation (pSAC)[5], potential Special Protection Areas (pSPAs) and proposed Ramsar sites should be considered to be of the same value as corresponding sites that have already been designated.

2.4.3 Habitats and species occurring within sites which have not been formally designated (e.g. potential local wildlife sites) should as a general rule be evaluated as part of the habitats and species assessments. Where surveys by the designating body have identified that a site meets the criteria for formal designation and it is in the process of being formally designated, then such sites can be assumed to be of the value prescribed by the designating body.

2.4.4 All habitats and species occurring within the boundaries of the designated site (including both features for which the site is designated and those that are not a reason for designation) should also be considered under the evaluation of habitats and species (as described below) to ensure that the subsequent assessment provides a true indication of potential effect on conservation status of these habitats/species.

2.4.5 It is not the role of the EcIA process to validate site designations but if a designated site is considered no longer to meet the criteria for designation, then the issue should be discussed with the relevant designating authority. Unless agreement is reached that the site does not match its current designation, then the current designated value should be used in the assessment.

[4] Sites are submitted to the European Commission as candidate Special Areas of Conservation (cSACs). Only following approval by the European Commission are they designated by the Member State as Special Areas of Conservation.
[5] Prior to its submission to the European Commission as a cSAC, a proposed SAC (pSAC) is subject to wide consultation.

## 2.5 Habitats

2.5.1 Habitats should be evaluated using published criteria for the recognition of sites supporting habitats of value at particular geographic scales. This will include criteria developed to identify habitats of international[6] or national[7] value. Similarly, some County Wildlife Trusts and/or Local Authorities have prepared criteria for the selection of local sites on the basis of their habitats.

2.5.2 Published criteria often make reference to UK priority habitats. The UK Biodiversity Action Plan[8] defines habitats and species that are conservation priorities because of their rarity and rate of decline. A review of the list of priority habitats in 2007 led to the identification of 65 habitats that meet the criteria at UK level. While the UK BAP has now been superseded, the priority habitat definitions remain relevant as they also underpin the Habitats of Principal Importance under Section 41, (S41) of the Natural Environment and Rural Communities Act (2006)[9], which mirror the categories originally defined for the UK BAP. Fifty-six habitats of principal importance are included on the S41 list. These are all the habitats in England that have been identified as requiring action in the UK Biodiversity Action Plan (UK BAP). They range from habitats such as upland hay meadows to lowland mixed deciduous woodland and from freshwater habitats such as ponds to marine habitats such as subtidal sands and gravels.

2.5.3 The published selection criteria typically take account of the following:

- rare or uncommon habitats;
- typical or characteristic habitats;
- species-rich habitats;
- habitats that develop slowly and are thus difficult to replace; and
- local context.

2.5.4 Where criteria for recognising habitat receptors of value at a county or district level do not exist, experience and professional judgement should be used for their evaluation. Justification for the value assigned to any habitat or site should be clearly and concisely set out, focusing on the factors listed in paragraph 2.5.3.

2.5.5 The evaluation of habitats should be made independent of any related value that the habitat has as a consequence of the protected species which it supports.

2.5.6 Assessment should include consideration not only of similar habitats but also the potential for a greater overall value of a wider habitat mosaic, as a consequence of what might be regarded as a synergistic assessment. Thus, an area that is of district value for several different habitats might be considered, overall, to be of county value as a consequence of the combination of habitats. Such judgements should be documented clearly.

[6] McLeod, CR, Yeo, M, Brown, AE, Burn, AJ, Hopkins, JJ, & Way, SF (eds.) (2005), The Habitats Directive: selection of Special Areas of Conservation in the UK. 2nd edn. Joint Nature Conservation Committee, Peterborough. www.jncc.gov.uk/SACselection.
[7] JNCC, Guidelines for selection of biological SSSIs. http://jncc.defra.gov.uk/page-2303 Accessed 06/08/13.
[8] JNCC (1994), *UK Biodiversity Action Plan*.
[9] *Natural Environment and Rural Communities Act* (2006), (Chapter 26). HMSO.

2.5.7 Habitats within designated sites should also be considered within the evaluation of the wider habitat resource. Cross referencing to the designated sites section should be used as appropriate to prevent the need to repeat baseline descriptions.

## 2.6 Species

2.6.1 As with habitats, there will usually be published criteria for assessment of sites supporting species and assemblages of species that are considered as qualifying features for designated sites of nature conservation value at different geographic scales (e.g. The Birds Directive: selection guidelines for Special Protection Areas (JNCC, 1999)[10].

2.6.2 Published criteria often make reference to UK priority species. The UK Biodiversity Action Plan (1994) defines habitats and species that are conservation priorities because of their rarity and rate of decline. A review of the list of priority species in 2007 led to the identification of 1,150 species that meet the criteria at UK level. Species were assessed according to four criteria:

- threatened internationally;
- international responsibility and a 25% decline in the UK;
- more than 50% decline in the UK; or
- other important factors, where quantitative data on decline were lacking but there is other evidence of extreme threat.

2.6.3 While the UK BAP has now been superseded, the priority species definitions remain relevant as they also underpin the Species of Principal Importance under Section 41 of the Natural Environment and Rural Communities Act (2006), which mirror the categories originally defined for the UK BAP. There are 943 species of principal importance included on the S41 list. These are the species found in England which have been identified as requiring action under the UK BAP. In addition, the Hen Harrier has also been included on the S41 list because without continued conservation action it is unlikely that the Hen Harrier population will increase from its current very low levels in England.

2.6.4 Other criteria typically take account of the following:

- rare or uncommon species;
- species suffering a marked decline;
- endemic species;
- typical or characteristic species;
- species for which the area holds a significant proportion (e.g. European species for which England holds a significant proportion); and
- large or notable populations of species.

[10] Joint Nature Conservation Committee (1999), The Birds Directive: Selection Guidelines for Special Protection Areas, 6 pages, A5 leaflet, ISBN 1 86107 477 8

2.6.5 Protected and/or notable species should be evaluated wherever possible at the population level. Assessment teams should liaise to ensure that similar assumptions are made in relation to the scale of evaluation for highly mobile species such as bats and birds.

2.6.6 Protected species populations occurring within designated sites should also be evaluated within this section at an appropriate scale (i.e. the boundaries of the designated site should not be a constraint to the way in which the resource/receptor is evaluated).

2.6.7 Species populations found at the edge of or beyond their natural range may be worthy of valuing highly or not. A case-by-case judgement is likely to be appropriate in this situation and should be briefly explained in the baseline evaluation.

2.6.8 All the criteria listed previously should be employed in the context of professional understanding. Some species that have suffered a decline in numbers may still be common or may be expected to recover and so may not be valued as highly as other species in this category.

2.6.9 The IEEM Guidance distinguishes between the evaluation of species of biodiversity value and those that are legally protected. In many cases, species fall in to both categories, thus, for example, great crested newt (Triturus cristatus) is protected under the Habitats Directive and the Wildlife and Countryside Act because it is considered to be of biodiversity value. The distinction between biodiversity value and legal protection allows one to draw the necessary distinction between the importance of a single pond with great crested newt and a series of ponds with a metapopulation that would quality for designation as a SSSI.

## 2.7 Baseline trends

2.7.1 The impact assessment considers the baseline conditions that would exist with and without the Proposed Scheme. It is therefore important to predict baseline conditions for the construction period (for construction impacts) and for the date of opening and beyond (for operational impacts). Key dates are provided in Table 1.

Table 1: Assessment years

| Phase | Year(s) |
|---|---|
| Base year | 2012/2013 |
| Construction | 2017-2026 |
| Operation Year 1 | 2026 |

Source: HS2 EIA Scope and Methodology Report

2.7.2 Due to the complexity of the scheme and the potential for changes in construction phasing when detailed design is progressed, the ecological assessment will be based on the assumption that construction activity across the route will commence in 2017.

2.7.3 In predicting future baseline conditions at the start of construction and operation, consideration should be given to environmental trends (range expansion, population declines etc.) as well as influences such as policy that will influence land use, and consented or highly likely development proposals.

2.7.4 Based on current best evidence, it is considered unlikely that ecological features will be significantly different by either 2017 (construction baseline) or 2026 (operational

baseline). The EcIA therefore concentrates on reporting the likely effects of climate change at the route-wide level within Volume 3.

## 2.8 Precautionary valuation

2.8.1 Due to access restrictions, access delays and seasonal restrictions on survey, there will be areas of the route where the desired survey scope will not be complete at the point of ES submission.

2.8.2 In order to ensure that all likely significant effects of the Proposed Scheme have been identified, where baseline information is incomplete a precautionary approach of assuming a 'reasonable worst-case' valuation should be adopted. This approach should be utilised to assign precautionary valuations to both known receptors, and potential receptors based on the best available information.

2.8.3 Where reasonable worst-case valuations are necessary they should be made based on the information available. This should include consideration of any available field or desk study data (including aerial photography), a comparison with similar habitat areas occurring in the wider local area, and a qualitative consideration against any factors that indicate suitability for the particular habitat or species in question. The degree of precaution built into the assessment should be linked to the level of confidence in the existing data upon which the assessment is based. Further guidance is provided in Appendix B.

# 3 Impacts

## 3.1 Construction impacts

3.1.1 Site preparation and construction activities will include:

- demolition of buildings;
- clearance of vegetation;
- site levelling;
- earthworks including: excavation, topsoil/subsoil stripping;
- laying of substrates and construction materials;
- introduction of railway infrastructure, including caternary system;
- storage of machinery and materials;
- security and site lighting;
- installation of site fencing (temporary and permanent);
- construction and installation of noise fence barriers;
- planting of landscaping areas;
- construction of roadways, underpasses and bridges where re-alignment of existing roads are required;
- construction of paths, underpasses and bridges where re-alignment of public rights of way (footpaths and bridleways) are required;
- culverting of watercourses under the railway line;
- construction of ditches, drains and watercourses where new or realigned drainage is required; and
- transport of materials and workers to and from site.

3.1.2 The construction area will include land required for mitigation, notably noise barriers and landscaping areas. It will also include land required for road and utility re-alignment.

3.1.3 Impacts arising from the permanent presence of the railway line, associated structures (including catenary), and landscaping etc. are considered to be permanent construction effects and should be reported in the construction section.

3.1.4 Potential impacts resulting from site preparation, construction activities and the permanent presence of the route are likely to include:

- loss of habitat to land required for the construction and operation of the Proposed Scheme;
- severance of ecological corridors and networks, resulting in a reduction in habitat connectivity;

- fragmentation of habitats and sites;
- barrier effects (to movement of fauna);
- direct mortality from collision with overhead structures, including catenary system;
- noise and visual disturbance;
- vibration disturbance;
- disturbance from lighting;
- dust deposition;
- air pollution;
- water quality changes from surface water run-off carrying sediments and pollutants;
- hydrological effects, from changes in water levels and/or flows;
- changes in management, often resulting in habitat degradation;
- changes in public access;
- introduction of 'alien' geology where use of imported substrates results in mixed geologies; and
- introduction and spread of non-native invasive species.

3.1.5 It should be noted that changes in public access may affect sites some distance from the Proposed Scheme. If, for example, an area of much-used public open-space is lost to the community, either temporarily or permanently, other sites may see a consequent increase in use. Thus, the usual potential effects of increased recreational use (disturbance to sensitive species, eutrophication, erosion, increased risk of fire etc.) may occur well away from the Proposed Scheme where alternative sites are in short supply.

3.1.6 It will be assumed for the purposes of the EcIA that all existing habitats within the extent of the Proposed Scheme (i.e. both areas of land required for the construction and operation of the Proposed Scheme) would be permanently lost. This represent a precautionary assessment and it is likely that during detailed design it will be possible to identify some features that can be retained.

## 3.2 Operational impacts

3.2.1 Operational activities will include:

- passage of trains; and
- maintenance activities.

3.2.2 Operational impacts derive only from these activities and do not include the permanent presence of the railway line, associated structures (including catenary, landscaping etc.).

3.2.3 Potential impacts resulting from operational activities are likely to include:

- barrier effects (to movement of fauna);
- direct mortality or injury from collision with trains;
- mortality or injury from potential turbulence effects;
- noise and visual disturbance;
- vibration disturbance;
- water quality changes from surface water run-off carrying sediments and pollutants (both from routine activity and accidental spillages); and
- introduction and spread of non-native invasive species.

## 3.3 Characterising impacts

3.3.1 Having identified the impacts that are likely to arise from construction and/or operational activities at any one location, it is necessary to consider the characteristics of impacts in terms of:

- positive or negative;
- magnitude;
- spatial extent;
- duration;
- timing (both in terms of time of day and time of year); and
- frequency and periodicity.

3.3.2 These characteristics are important in determining likely ecological effects.

3.3.3 Magnitude refers to the 'size' or 'amount' of the impact and should be reported on a quantitative basis wherever possible. The extent of an impact is the area over which the impact occurs and this again should be reported on a quantitative basis.

3.3.4 The duration of impact should be considered in relation to ecological characteristics (for example species lifecycles) as opposed to human timeframes (IEEM guidelines). It should be noted that the duration of the impact and the resulting effect on receptor may differ. For example if disturbance during construction results in several years of reduced juvenile recruitment for a species then the effect on the conservation status of the species concerned may continue to be significant for generations.

3.3.5 When describing the reversibility of impacts, the terms 'permanent' (i.e. irreversible) and 'temporary' (i.e. reversible) should be used when characterising an impact.

3.3.6 Within the characterisation of impact an indication should be provided of the likelihood that a change/activity will occur as predicted. Only a qualitative description should be provided, as industry experience of adopting the four-point scale provided within the IEEM guidelines has found this scale difficult to apply objectively.

3.3.7 In line with the overall Environmental Impact Assessment of the Proposed Scheme, the EcIA will make a clear distinction between the terms 'impact' and 'effect', using the definitions below:

- impact = activity associated with the Proposed Scheme resulting in changes acting on an ecological receptor; and
- effect = outcome resulting from an impact acting upon a receptor.

# 4 Assessment of effects

## 4.1 Definition of significance

4.1.1 Having defined and assessed both the baseline ecological resources and the predicted impacts, it is necessary to consider how the predicted impacts could affect the valued ecological resources and thus to identify likely significant ecological effects.

4.1.2 Following the IEEM guidance, a significant ecological effect is defined as 'an effect (negative or positive) on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a given geographical area'.

4.1.3 Impacts on designated sites will be considered in relation to the effect on the integrity of the site involved. Effects on species and habitats will be considered in relation to the concept of 'conservation status'.

## 4.2 Assessment of whether ecological effects are significant

4.2.1 In line with the approach laid out in the IEEM guidelines, the value of resources/receptors will be used to identify the geographic scale at which the effect is significant.

4.2.2 Effects of the Proposed Scheme will be assessed following the incorporation of avoidance/mitigation measures that are included within the design. This will include all relevant measures even if their primary purpose was not to reduce or avoid ecological impacts. For example this may include the following:

- changes to the route (i.e. horizontal alignment) of the scheme;
- changes to the vertical alignment (e.g. depth of cuttings);
- use of tunnels;
- design of standard bridges, overpasses etc. (excludes green bridges[11] or the greening of structures already proposed);
- use of specific construction methodology to minimise the land required (e.g. retaining walls);
- underpasses/conduits where the primary purpose is not for ecological benefit;
- fencing where the primary purpose is not ecological; and
- implementation of the Code of Construction Practice (CoCP).

4.2.3 Effects should be reported prior to any additional mitigation, compensation or enhancement proposed, which will be introduced later in the assessment process.

4.2.4 Key to predicting significant ecological effects is understanding what might affect the integrity of a defined site and/or the conservation status of the habitats or species supported by the defined site or area.

[11] Green bridge is a structure with vegetation, providing habitat connectivity across the route of the Proposed Scheme.

4.2.5 IEEM Guidance recommends that the process of identifying significant ecological effects should make explicit reference to aspects of ecological structure and function on which the feature depends.

4.2.6 The integrity of a site is defined as 'the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified'[12]. For all designated sites the assessment of the effect on site integrity should only consider the features for which the site is designated.

4.2.7 Once impacts that could affect a site have been identified, they can be evaluated against the environmental factors necessary to maintain the integrity of the site, with consideration being given to the timing, duration, reversibility, extent and magnitude of any effect. Professional judgement will be used, as appropriate, to make the final judgement as to whether there will be a significant effect.

4.2.8 For designated sites of international and national importance, assessment of the potential effects on integrity should make explicit reference to any published conservation objectives.

4.2.9 Similarly, for some species and habitats (notably those with Biodiversity Action Plans) there may be objectives for the conservation status of the species/habitat.

4.2.10 Where impacts are anticipated to result in an adverse effect on site integrity, then this should be considered significant at the same geographical scale at which the site is valued. However, when considering adverse effects on conservation status of habitat and species, where an effect is not found to be significant at the level at which the resource/receptor has been valued, it may in some cases be significant at a lower level.

4.2.11 A 'worst case' rule is to be applied to assessment of the future baseline, in order to take account of uncertainty: significance of effect outcomes arising through the future baseline will only be reported where effects worsen over those reported against the current baseline. As a result of this rule, mitigation and compensation will be provided in line with a 'worst case' assessment.

## 4.3 Cut-offs for reporting purposes

4.3.1 Individual effects at the local/parish level are as a general rule not to be reported in Volume 2 CFA reports as they are not considered to represent material considerations in the decision-making process for the Proposed Scheme. Exceptions may be made where it is considered necessary to demonstrate that particular issues have been considered, such as where an adverse effect occurs at a lower geographic scale than that at which the receptor was valued.

4.3.2 A register of local/parish level effects will be produced and will form an appendix to the ES (Volume 5 Appendix EC-005-001 to EC-005-004). Potential cumulative and in combination effects of multiple local/parish level effects will be considered in the route-wide assessment (Volume 3 of the ES).

[12] ODPM Circular 06/2005; Biodiversity and geological conservation – Statutory obligations and their impact within the planning system.

## 4.4 Cumulative effects[13]

4.4.1 Cumulative effects include:

- the combined ecological effect on a single receptor of a number of individual environmental impacts (e.g. the loss of habitat to land required for construction and operation of the Proposed Scheme, combined with noise and airborne dust) arising from the Proposed Scheme;
- the cumulative effects of localised ecological impacts along the length of the Proposed Scheme; and
- interaction between ecological effects arising from the Proposed Scheme and those from other relevant projects and plans which take place during the construction or operational phases.

4.4.2 The cumulative effects resulting from the accumulation of effects summed in a regional context or over the whole route, resulting in an effect or effects of greater significance than the sum of the individual effects, will be reported in the route-wide report (Volume 3 of the ES).

4.4.3 The wider effects of climate change on the likely effects as a consequence of the Proposed Scheme, and the effects of the scheme on the ability of habitats and species to respond to future pressures of climate change, will be reported primarily as part of the route-wide ecology assessment in Volume 3.

4.4.4 Studies concluded that the effects of climate change, when considered in combination with predicted effects arising from construction and operation of the Proposed Scheme, may exacerbate the ecological effects of the Proposed Scheme but are unlikely to result in any effects of greater significance. Nonetheless, consideration will be given to the situations in which ecological effects arising from future climate change may exacerbate the effects of the Proposed Scheme (see Table 6 within the SMR Addendum text relating to climate change) and any consequent changes in levels of significance will be reported within the CFA reports. In particular, if the in-combination analysis suggests that existing mitigation measures need to be enhanced or additional mitigation is required, this will be clearly identified. For the purposes of this analysis, '2020' climate predictions will be used for construction effects and '2050' for operational effects. In addition, any regional or local policies and guidance on climate change impacts, risks and adaptation will be considered.

[13] A future development is considered to be part of the future baseline if it changes the local environment (or creates additional receptors) prior to 2016 or 2027 (for construction and operational future baselines, respectively); it is considered to contribute cumulative effects if its construction or operation occur contemporaneously with HS2 and increase the effects of HS2 on receptors.

# 5 Mitigation, compensation and enhancement

## 5.1 Approach to mitigation, compensation and enhancement

5.1.1 Following the assessment of effects the Volume 2 CFA ecology reports will present details of the further mitigation, compensation and enhancement measures (i.e. those in addition to the fundamental engineering design) that are proposed to address the anticipated effects. In describing such measures terminology should explicitly distinguish between mitigation, compensation and enhancement as defined within the IEEM guidelines.

5.1.2 For each significant adverse ecological effect, appropriate mitigation or compensation will be identified where feasible. This mitigation or compensation proposed will be informed by professional judgement, experience, and an understanding of the factors that contribute to the integrity of a site and to the conservation status of a species or habitat.

5.1.3 Overall, in line with Government policy, the project is seeking to achieve no net loss in biodiversity at the route-wide level.

5.1.4 In defining and making recommendations for appropriate measures to address significant effects their deliverability should be considered, along with certainty about their likely success. Measures which are unlikely to be successful (probability estimated at below 50%) should not be included. Rather, certain/near-certain (probability estimated at 95% chance or higher) or probable (probability estimated above 50% but below 95%) measures should be recommended. For measures for which the success is regarded as 'probable', recommendations for monitoring/corrective action are likely to be appropriate.

5.1.5 Recommendations about timing of mitigation/compensation/enhancement measures should be made where these are relevant to the likely effectiveness of the proposed measures to address predicted adverse effects.

5.1.6 Where there remain significant ecological effects that it is not possible to reduce below the level of significance by mitigation, compensation or enhancement will be provided.

5.1.7 Proposals for enhancement and measures designed as compensation for residual effects are sometimes confused. They are distinct, in that appropriate compensation measures should address specific residual impacts and should be designed to provide, as far as possible, direct replacement of any habitats lost. In contrast, enhancement measures could be entirely unrelated to any adverse effects of the Proposed Scheme.

5.1.8 Planting provided for the primary purpose of landscaping should also be reported as compensation where its provision is also of ecological benefit.

## 5.2 Location of compensation/enhancement provision

5.2.1 The provision of mitigation, compensation and enhancement required to address the effects of the scheme will primarily be reported at the level of the individual CFA (Volume 2 of the ES). However, such provision will not necessarily be provided within

the same CFA as the adverse effects occurred, where greater ecological benefits can be achieved by pooling habitat creation or providing in another location. In such circumstances, compensation/enhancement provisions should be described in the CFA in which the provision will be made. They should then be cross-referenced in the mitigation, compensation and enhancement section of the CFA where the effect occurred, in order to ensure that the reasoning for residual effects is clear.

# 6 Residual effects

## 6.1 Introduction

6.1.1 Following the description of all mitigation, compensation and enhancement measures proposed, the residual effects section will consider the net effects of the scheme once these measures have been implemented.

6.1.2 Significant effects on habitat types which are considered irreplaceable (e.g. ancient woodland) should be listed as a significant residual effect even where compensation or enhancement is proposed. In such cases the loss of irreplaceable habitat should be identified as an adverse effect. Where compensation has been provided to address this effect then a corresponding 'beneficial' effect (and a geographic level of significance) may be identified for any compensation/enhancement provision proposed to offset the losses.

6.1.3 This approach is likely to be utilised mainly in relation to impacts of the Proposed Scheme on ancient woodlands. It is intended to reflect the view that some habitats (e.g. ancient woodland) and features are irreplaceable and as such cannot be offset on a 'like for like' basis. In this instance the 'beneficial' effect will be included to demonstrate the positive value of the proposed compensation, while acknowledging that the new habitat cannot replace ancient woodland.

6.1.4 For all other significant effects identified prior to the incorporation of mitigation, compensation and enhancement, consideration should be given as to whether the proposed measures are sufficient to offset effects. Where this is the case these effects will be considered to have been addressed, and no significant residual effect will be reported. Where mitigation, compensation or enhancement provision is not likely to reduce the effect below the level of significance, this will be reported as a significant 'residual effect'.

## 6.2 Consequences of significant residual effects

6.2.1 The consequences in legal and policy terms of significant residual effects of the Proposed Scheme will be presented within the route-wide assessment in Volume 3. As described in the IEEM guidelines (paragraph 6.1), such explicit presentation enables the decision-making body to ensure that the Proposed Scheme:

- complies with legal requirements e.g. the need to obtain a licence for any work affecting protected species or the implications in respect of the Conservation (Natural Habitats) Regulations[14];
- meets international, national and local policy objectives; and
- requires conditions and legal obligations attached to the consent that deal with aspects of the detailed design and implementation of the project.

[14] HMSO (1994), *The Conservation (Natural Habitats, &c.) Regulations 1994 No. 2716.*

# Appendix A: Resource evaluation criteria

Table A1: Resource evaluation criteria table

| Value of resource | Selection criteria |
|---|---|
| International | An internationally designated site or candidate/proposed site (SPA, pSPA, SAC, cSAC, pSAC and/or Ramsar site, pRamsar site).<br><br>A sustainable area of a habitat which is significant at an international level and which is capable of meeting the criteria for designation as a site of international importance.<br><br>A sustainable population of a species which is significant at an international level and which is capable of meeting the relevant criteria for designation as a site of international importance. |
| National | A nationally designated site (SSSI, NNR, Marine Nature Reserve).<br><br>A sustainable area of a habitat which is significant at a national level and which is capable of meeting the criteria for designation as a site of national importance.<br><br>A sustainable population of a species which is significant at a national level and which is capable of meeting the relevant criteria for designation as a site of national importance. |
| Regional | Sites/populations which exceed the County or Metropolitan-level designations but fall short of SSSI selection guidelines.<br><br>A sustainable population of a species which is significant at a regional level and which is capable of meeting the relevant criteria for designation as a site of regional importance. |
| County/ metropolitan | Some locally designated sites (including Local Wildlife Sites and Sites of Metropolitan Importance for nature conservation).<br><br>A sustainable area of a habitat which is significant at a county level and which is capable of meeting the criteria for designation as a site of county importance.<br><br>A sustainable population of a species which is significant at a county level and which is capable of meeting the criteria for designation as a site of county importance. |
| District/borough | Some designated sites (e.g. Sites of Borough Importance).<br><br>Sites/features which are scarce within the District/Borough or which appreciably enrich the District/Borough habitat resource. |
| Local/parish | Sites/populations, which appreciably enrich the immediate vicinity or parish habitat resource (e.g. moderately species-rich hedgerows) but which are not in themselves of district/borough importance. |
| Negligible | Habitats or species populations that do not appreciably enrich the ecological value of the immediate vicinity. |

N.B. Local Nature Reserves may be of value at a range of geographic levels and professional judgement should be applied based on consideration of the specific features for which the site is designated.

# Appendix B: Approach to precautionary assessment

1.1.1 Due to access delays and refusals it has not been possible to access all areas identified as falling within the desired scope of ecology surveys. As a consequence the ecological impact assessment (EcIA) will in some situations be based upon limited or incomplete data.

1.1.2 In order to comply with requirements of the Environmental Impact Assessment Directive (85/337/EEC) it is necessary for the ecology sections of the Environmental Statement (ES) to identify the 'likely significant effects of the proposed project'. In order to comply with the requirements of the Directive in the absence of a full data set it is necessary to adopt a precautionary approach and attempt to identify those effects which are likely to be significant based on the available information. Case law demonstrates that it is not acceptable to simply rely upon the defence that survey work to be undertaken at a later date will identify where significant effects are likely to occur.

## Baseline valuation

1.1.3 The level of information available to inform the valuation of ecological receptors within the EcIA will vary widely.

### *Complete access – complete field survey information available*

1.1.4 Where full baseline information (i.e. information to the level that would typically support an environmental statement) is available to inform the valuation process, then the standard approach to valuation as outlined within the IEEM guidelines should be followed.

1.1.5 For all such valuations, receptors should be firmly attributed to the most appropriate geographical frame of reference. The use of precautionary terminology such as 'up to' or 'likely to be' should not be utilised for the valuation of receptors that fall into this category.

### *Partial or no access – incomplete field survey or desk study information only*

1.1.6 Where it has not been possible to complete field survey to a level that would normally be appropriate in support of an environmental statement, then it will be necessary to make a precautionary assessment.

1.1.7 For habitats it is likely that it will be possible to identify potential resources/receptors to a reasonable level of detail through analysis of aerial photography (e.g. woodland at Location 1).

1.1.8 For species receptors where some field survey has been undertaken, but it is incomplete, it is likely to be possible to identify the receptor or potential receptor to a reasonable level of detail.(e.g. bat assemblage at Location 2, or potential amphibian population associated with ponds at Location 3).

1.1.9 Where no field survey access has been possible, in the first instance an attempt should be made to identify individual receptors through review of aerial photography and other relevant available existing information(e.g. potential bat assemblage associated with unsurveyed woodland at Location 3).

1.1.10 Where this is not possible then it will be necessary to provide a collective precautionary valuation at the community forum area (CFA) level (e.g. other bat populations within the Location4 area).

1.1.11 In all such situations a precautionary valuation that represents a 'reasonable worst-case' is to be provided, i.e. one that is precautionary but it is reasonable to assume could occur, rather than an extreme scenario that is on balance unlikely. In all such cases where the baseline is incomplete the degree of precaution built into the assessment should be linked to the level of confidence in the existing data upon which the assessment is based.

1.1.12 For example, it is considered reasonable to assume that, within a network of partially surveyed ponds (in a locality where several small great crested newt populations have been found to occur), further populations of great crested newt may be identified, and that these would likely be of small or medium population size class. However, it would not normally be reasonable to assume that every pond where survey is incomplete is likely to support a high population of great crested newts.

1.1.13 For each potential receptor a reasonable worst-case valuation should be attributed based on the information available. This should include consideration of any available field or desk study data (including aerial photography), a comparison with similar habitat areas occurring in the wider local area, and a qualitative consideration against any factors that indicate suitability for the particular habitat or species in question.

1.1.14 In all cases throughout the paragraph and table text in Volume 2 (CFA reports) it should be made clear where a precautionary approach has been adopted through the use of the qualifier 'up to' alongside the relevant geographic frame of reference.

## Impact assessment

1.1.15 Where a precautionary valuation has been made, and an effect significant at the district/borough level or higher is possible, then a description of the likely impacts as a consequence of the Proposed Scheme should be provided. The description of impacts should be as specific as the knowledge of the baseline allows. For example it may be possible to say that a specific pond of up to district/borough value for amphibians is to be lost. However, a general statement may need to be made in relation to bats to say that activities in this area will result in the loss of trees and buildings which could support bat roosts.

1.1.16 The term 'could' (as opposed to 'will') is to be utilised in the assessment conclusions wherever a precautionary assessment of 'up to' X value has been necessary (e.g. this could result in an adverse effect that is significant at up to the county/metropolitan level).

## Mitigation and compensation provision

1.1.17 For habitat losses it is likely that it will be possible to provide a clear indication as to how potential effects occurring on receptors that have not been accessed for survey

will be mitigated or compensated. In most cases, as the broad habitat type will be discernible from aerial photography, it is likely that habitat losses will have been accounted for within the mitigation and compensatory provision that has been incorporated into the mitigation schedules.

1.1.18 For protected species, in many cases it will not be possible to specifically identify the required level of mitigation/compensation, as the exact nature of the impacts will not be discernible until it is possible to access land and gain a fuller understanding of the baseline. Therefore, a commitment will be made to providing mitigation/compensation in line with a set of agreed principles of mitigation for the species concerned.

# HS2 London-West Midlands

# Ecology

# Technical note- Ecological principles of mitigation

## A report to HS2 Ltd by Arup/URS

# Contents

**List of figures**

# 1 Introduction

1.1.1 This document is a technical note that has been produced in support of the Environmental Impact Assessment (EIA) for Phase One London - West Midlands of the proposed High Speed 2 (HS2), the construction of a new railway line between London and Birmingham (hereafter the 'Proposed Scheme'). It details the ecological principles that will be applied in designing the mitigation and compensation to be provided in support of the Proposed Scheme.

1.1.2 Application of the principles outlined in this document to the detailed design of ecological mitigation and compensation aims to ensure that adverse effects that have been identified within the Environmental Statement are addressed and will not be exceeded.

1.1.3 During 2012 and 2013 a combination of field survey and desk based study (to identify pre-existing relevant information) has been undertaken to inform the Environmental Statement (ES) for Phase 1. However, due to access delays and refusals in combination with the seasonal constraints to survey, it has not been possible to achieve access to all areas where survey was proposed. As a consequence, in the absence of full data in some cases it has been necessary to apply a precautionary approach within the ES. Available information has been utilised to provide an assessment based on a predicted 'reasonable worst-case' scenario.

1.1.4 In addition at hybrid Bill submission the Proposed Scheme will still be subject to completion of detailed design, which includes landscape design. An outline landscape design will be available on submission of the hybrid Bill.

1.1.5 For the above reasons the Environmental Statement does not contain all of the details of the mitigation or compensation required for impacts on protected and/or notable habitats and species. As a consequence this document sets out the principles of the ecological mitigation strategy in order to provide decision makers with confidence that the adverse effects will be adequately addressed. It also aims to support conclusions of no significant effect reported in the ES.

1.1.6 At all stages in the application of these principles full consideration has been and will be given to the implementation of the mitigation hierarchy (i.e. avoid-reduce-mitigate-compensate). Where it is reasonably practicable to do so then attempts have been made to avoid impacts. Where impacts cannot be avoided then efforts have been made to limit the extent and magnitude of the impact and to mitigate the resultant effects through the provision of appropriate measures. Where effects cannot be mitigated to a level where they are not significant then compensatory measures have been employed to (as far as is reasonably possible) offset any remaining adverse effects.

1.1.7 This document deals principally with the last two steps in this mitigation hierarchy namely the provision of mitigation and compensation. The land considered to be required for the implementation of such measures has been included in the Proposed Scheme on a precautionary basis, based on a 'reasonable worst-case'. Application of the principles of mitigation contained within this document will, once access to complete surveys has been gained, act to guide the development of the detailed design of mitigation/compensation measures to be provided in these areas.

1.1.8 Where mitigation or compensation are required then the intention is to provide them within the confines of the land required for the construction of the Proposed Scheme as defined on the Parliamentary plans. Where this is not reasonably practicable than further means of providing mitigation/compensation provision beyond the land controlled by the Proposed Scheme will be considered.

# 2 Great crested newt

## 2.1 Key principles

2.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any long term adverse effect on the favourable conservation status (FCS) of those great crested newt populations located in the vicinity of the route.

2.1.2 The nominated undertaker will seek to provide new aquatic and terrestrial habitat for great crested newt primarily within locations that have connectivity with retained habitat that is already utilised by the populations affected (i.e. in-situ). In doing so compensatory habitat creation will seek to avoid any long term effect on FCS through ensuring that the key impacts of habitat loss (both aquatic and terrestrial) and potential severance are addressed. Such provision will include both the creation of new core areas of habitat specifically designed for great crested newt, and the enhancement of compensation areas which have already been incorporated to address losses of particular habitat types. For example, the design of areas of broadleaved woodland planted to compensate for losses of this habitat type may be altered to allow these areas to also incorporate great crested newt breeding ponds.

2.1.3 However, for a scheme of this scale it is likely that there will be locations where there is no-satisfactory alternative to providing compensatory habitat in locations that are distant from the impact. Where this approach is necessary then disease screening (including that for chytridiomycosis) will be undertaken in line with current best practice to ensure that all populations involved are free from disease at time of translocation.

2.1.4 Where it is not reasonably practicable to address the possible impact of the local population in-situ then opportunities will be taken to consolidate compensation provision as part of larger scale habitat creation areas. Where reasonably practicable to do so, all such compensation areas would be provided in close proximity to the route, through the creation of areas of high quality terrestrial and aquatic habitat.

2.1.5 As well as providing a receptor for those populations where translocation in-situ is not possible due to other constraints, large scale habitat creation areas have been provided within the land required for the construction of the Proposed Scheme to address a 'reasonable worst-case' in relation to those ponds which it is has not been possible to access for survey. Such areas have been provided at regular intervals throughout the route in order to minimise impacts on the conservation status of the populations concerned at the local level.

2.1.6 Once constructed the railway is for the majority of the route considered unlikely to form an absolute barrier to great crested newt movement. Amphibians are known to utilise habitats that are common to operational railway corridors, including the use of gaps between ballast as refugia and/or hibernacula. However, the presence of the operational railway is likely to reduce exchange of individuals between water bodies either side of the route, and in some cases (e.g. where the route is in deep cutting or on steep sided embankment) then it has the potential to act as a barrier to movement.

2.1.7 Where severance is identified as having the potential to result in an adverse effect on conservation status, the nominated undertaker will seek to minimise its effects

through implementing habitat creation/restoration to increase connectivity with other known areas of suitable habitat in the landscape, and maintain the viability of these severed elements, for example by providing linear connectivity and new ponds which will promote connectivity between two previously separate metapopulations.

2.1.8 In extreme situations where it is not considered possible to maintain the viability of severed fragments of a population affected by the Proposed Scheme then the nominated undertaker will consider the trapping of great crested newts from land that lies outside the extent of the Proposed Scheme, in order to allow the full population to be relocated to the same receptor site.

2.1.9 The use of amphibian tunnels as a potential method for addressing the effects of severance will be considered on a case by case basis and reviewed against the current evidence basis for their effectiveness at the time of construction. However, based on the current limited evidence for their effectiveness such measures are currently not relied upon in the mitigation/compensation strategy outlined in the ES.

## 2.2 Aquatic habitat creation

2.2.1 Where ponds supporting great crested newt are lost then they will be compensated through either:

- provision of two replacement ponds (of similar size) for each pond lost (a minimum pond surface area of 100m$^2$ would be applied); or
- provision of approximately double the surface area of suitable aquatic habitat through the creation of larger ponds than those lost (a minimum pond surface area of 100m$^2$ and a maximum of 300m$^2$ will apply).

2.2.2 Where possible replacement ponds will be provided in locations that maintain connectivity with retained elements already utilised by the populations affected (i.e. in-situ).

2.2.3 The construction schedule will ensure that where ponds are to be lost then any new ponds will (wherever reasonably practicable to do so) be created 6 months prior to the commencement of any translocation works in order to allow the plant and invertebrate populations to establish.

2.2.4 The planting regime will be appropriate to the local area, and in each case will include a variety of marginal, floating and submerged vegetation with some areas of open water. Where possible plant material and/or water from ponds to be lost will be used to promote rapid establishment of newly created ponds.

2.2.5 When siting new ponds those locations which are likely to be subject to high levels of human or animal disturbance will be avoided where practicable to do so. In addition surrounding terrestrial habitat creation and on-going management will be designed to avoid dense shading.

## 2.3 Terrestrial habitat creation

2.3.1 Where an adverse effect is anticipated on great crested newt as a result of the loss of terrestrial habitat then the nominated undertaker will provide compensatory habitat.

2.3.2 Provision will seek to maximise the quality of terrestrial habitat provided with regard to great crested newt, and ensure this is provided in close proximity to either retained or newly created ponds. However, provision of habitat in close proximity must be balanced with the need to ensure that links with other areas of surrounding suitable terrestrial habitat are maintained.

2.3.3 The loss of intermediate and distant terrestrial habitat is unlikely to result in adverse effects on those great crested newt populations where the quality and availability of terrestrial habitat in close proximity to the pond is high. However, in some cases such areas may play a key role. As such in all cases the requirement and scale of replacement terrestrial habitat will be considered on a case-by-case basis by ecologists experienced in European protected species mitigation (EPSM) licensing.

2.3.4 Where the requirement for compensatory habitat provision is identified, the nominated undertaker will endeavour to provide habitat of equal or higher quality than that which is lost. Habitats of similar type to those that are lost will be provided and hibernacula and other above ground refugia will be provided in each area of terrestrial habitat creation in order to maximise their potential carrying capacity.

2.3.5 Where replacement habitat is of equal quality to those areas lost then the area of replacement provision will be at least as large as the area lost (i.e. minimum of 1:1 ratio).

2.3.6 Where the quality of the terrestrial habitat to be provided post-construction will clearly be higher than that available pre-development, or habitat will be provided closer to the breeding pond, then compensation habitat areas provided may be on a less than 1:1 ratio. This may only be undertaken where it is not considered to be detrimental, to the population concerned, or the potential movement of amphibians through the wider landscape.

2.3.7 Planting of terrestrial compensation areas will utilise species appropriate to the local area, and where possible will seek to maximise the value of such areas for other species, without compromising their value for great crested newt.

2.3.8 All hibernacula, bunds and other refugia incorporated into the final designs will be constructed in accordance with current best practice guidelines (e.g. English Nature; 2001[1]; Langton et al 2001[2]).

2.3.9 Where newly created habitats are to act as receptor areas for great crested newt these areas will (wherever reasonably practicable to do so) be constructed a minimum of 6-12 months in advance of the commencement of translocation (depending on the type and seasonal timing of the works conducted).

## 2.4 Capture and exclusion

2.4.1 Capture and exclusion works will be undertaken in accordance with best practice guidelines, as currently detailed in Worksheet II E Mitign & Compn (5) of the great crested newt method statement -Form WML-A14-3[3]. Implementation of these

[1] English Nature (2001). *Great Crested Newt Mitigation Guidelines*. English Nature, Peterborough.
[2] Langton, T.E.S., Beckett, C.L., and Foster, J.P. (2001). *Great Crested Newt Conservation Handbook*. Froglife, Halesworth.
[3] Natural England (2012) *Template for method statement to support application for licence under Regulation 532(2)e in respect of great crested newts Triturus cristatus. Form WML-A14(3) (Version April 2013).*
http://www.naturalengland.org.uk/ourwork/regulation/wildlife/species/greatcrestednewt.aspx Accessed: 02/10/13.

methods will prevent any legal offences resulting from the killing/injury of great crested newt during site clearance.

2.4.2 Novel sustainable solutions to minimise the extents of exclusion fencing required by the Proposed Scheme will be explored and agreed with Natural England. Exclusion fencing (or equivalent) will be maintained for the duration of construction at those locations where there is considered to be a risk of amphibians re-entering construction areas post habitat clearance.

2.4.3 Permanent exclusion fencing will be incorporated in those locations where the operation of the scheme represents a significant risk to the favourable conservation status of the populations concerned, or where the presence of great crested newt within key areas of operational infrastructure has the potential to significantly constrain operational requirements.

## 2.5 Management, maintenance and monitoring

2.5.1 The nominated undertaker will commit to providing appropriate on-going management, maintenance and monitoring of compensatory habitats.

2.5.2 Details of route-wide commitments to on-going management, maintenance and monitoring will be developed in consultation with key statutory bodies, and will form part of the Environmental Minimum Requirements (EMR)[4] to be agreed at Royal Assent.

2.5.3 Detailed management, maintenance and monitoring strategies would be provided alongside derogation licence applications post Royal Assent.

[4] The Environmental Minimum Requirements are a series of commitments which will be agreed with stakeholders and made by HS2 Ltd at the point of Royal Assent. They aim to ensure that impacts that have been identified within the Environmental Statement are addressed and will not be exceeded

# 3 Common amphibians

## 3.1 Key principles

3.1.1 Where populations of common amphibians utilise the same areas of habitat used by great crested newts then effects on these species will be addressed through adherence to the principles of mitigation outlined in Section 2.1.

3.1.2 Where common amphibians occur in areas where great crested newt are absent then mitigation and compensatory habitat provision will seek to avoid significant effects on the populations concerned.

3.1.3 All new water bodies provided for common amphibians will be placed within areas of suitable terrestrial habitat that are being provided primarily to compensate for habitat losses as a consequence of the Proposed Scheme. These areas will be enhanced as necessary to also provide suitable replacement habitat for common amphibian populations.

3.1.4 Where translocation will involve movement of individuals to locations outside of the normal extent of that population then disease screening (including that for chytridiomycosis) will be undertaken in line with current best practice to ensure that all populations involved are free from disease at time of translocation.

## 3.2 Aquatic habitat creation

3.2.1 Where ponds containing other common amphibians are lost then these would be replaced on at least a 1:1 basis, and be of similar size and form to those lost.

3.2.2 This will be achieved through the provision of new water bodies suitable for use by common amphibians within the areas identified for provision of ecological mitigation/compensation outlined in Volume 5: Map series CT06.

## 3.3 Terrestrial habitat creation

3.3.1 Where the quality of the terrestrial habitat to be provided post-construction will be higher than that available pre-development, or habitat will be provided closer to the breeding pond, then compensation habitat areas may be on a less than 1:1 ratio. This may be undertaken where it is not considered to be detrimental to the population concerned, or the potential movement of amphibians through the wider landscape.

3.3.2 Planting of terrestrial compensation areas will utilise species appropriate to the local area. Hibernacula, bunds and other refugia will be provided as required in line with current best practice guidelines (e.g. English Nature, 2001[5]; Langton et al, 2001[6]).

3.3.3 Where newly created habitats are to act as receptor areas for common amphibians, these will wherever reasonably practicable to do so) be constructed a minimum of 6-12 months in advance of the commencement of translocation (depending on the type and seasonal timing of the works conducted).

[5] English Nature (2001). Great Crested Newt Mitigation Guidelines. English Nature. Peterborough.
[6] Langton, T.E.S., Beckett, C.L., and Foster, J.P (2001). Great Crested Newt Conservation Handbook, Froglife, Halesworth.

## 3.4 Capture and exclusion

3.4.1 Wherever it is reasonable to do so a controlled drain down of water bodies known to support breeding populations of common amphibians will be undertaken during the period mid-September to February inclusive, in order to minimise impacts on existing populations.

3.4.2 Based on the legal status of common amphibian the use of exclusion fencing and pitfall trapping will only be utilised where there is considered to be the potential for sufficiently high numbers of common amphibians to be killed or injured during construction that there would be a significant adverse effect on the population concerned. As a general rule the requirement for exclusion fencing and pitfall trapping will be considered in those locations which are known to support good or exceptional common amphibian populations.

## 3.5 Management, maintenance and monitoring

3.5.1 The nominated undertaker commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.

# 4 Bats

## 4.1 Key principles

4.1.1 The nominated undertaker will ensure that impacts as a consequence of the construction and operation of the Proposed Scheme do not result in any long term adverse effect on the favourable conservation status (FCS) of bat populations in the vicinity of the Proposed Scheme.

4.1.2 The nominated undertaker will seek to provide new roosting and commuting habitats for bat species primarily within locations that have connectivity with retained habitat that is already utilised by the populations affected (i.e. in-situ). In doing so compensatory habitat creation will seek to avoid any long term effect on FCS through ensuring that the key impacts of habitat loss (in relation to foraging, commuting and roosting activity), disturbance and potential severance are addressed. Such provision will include both the creation of new roost sites, and the enhancement of those compensation areas provided to address general habitat loss as a consequence of the Proposed Scheme, in order to make these areas more suitable for bats. For example, the design of areas of broadleaved woodland planted to compensate for loss of woodland habitat may be altered to provide a graded woodland edge that will be suitable for foraging activity of a range of bat species, or bat boxes incorporated to provide immediate replacement roosting opportunities.

4.1.3 Where it is not reasonably practicable to mitigate the likely effect on the local population in-situ then opportunities will be taken to consolidate compensation provision as part of larger scale habitat creation areas. All such compensation areas would (where reasonably practicable to do so) be provided in the closest most suitable location taking into consideration the following factors:

- type of roost;
- position in landscape; and
- design of the railway (for example in a cutting or at grade).

4.1.4 Large scale habitat creation areas have been provided as part of the wider ecological mitigation/compensation package in order to address a 'reasonable worst-case' scenario for all species in those areas where access has prevented full survey being conducted. Such areas have been provided at regular intervals throughout the route in order to minimise impacts on the FCS of the populations concerned at the local level.

## 4.2 Replacement roosting provision

4.2.1 Where bat roosts are lost they will be compensated in a form appropriate to the species of bat and type of roost in accordance with the guidelines provided in Figure 4 of the Bat Mitigation Guidelines (Mitchell-Jones 2004)[7].

4.2.2 Each roost to be lost would be compensated for as part of the mitigation scheme submitted as part of an EPSM licence application. The timing of operations such as provision of new roosting habitat, exclusion from roosts, and destruction will be

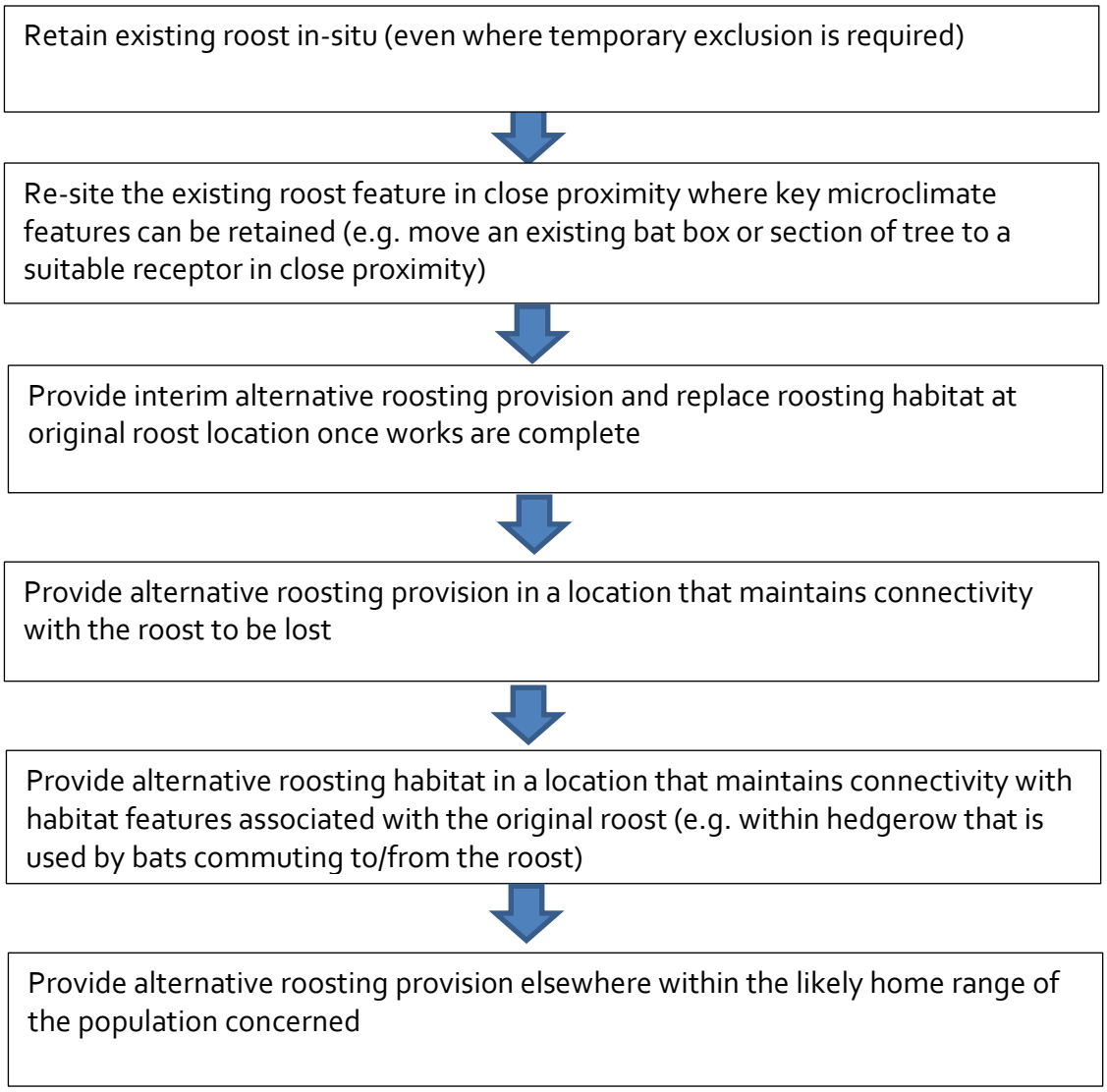
[7] Mitchell-Jones, A.J. (2004). *Bat Mitigation guidelines.* English Nature, Peterborough.

appropriate to the nature of the roost to be lost with works conducted in accordance with the recommendations of the Bat Workers Manual (JNCC 2004)[8].

4.2.3 Where a roost will be lost or disturbed as a consequence of works required in support of the Proposed Scheme, the hierarchy, shown in Figure 1 will be applied in considering the most appropriate way to mitigate for its loss.

[8] Joint Nature Conservation Committee (2004). Bat worker's Manual, 3rd Edition, edited by A.J. Mitchell-Jones and A.P. McLeish.

Figure 1: Mitigation hierarchy to be applied when a bat roost is lost




4.2.4 In considering the above hierarchy in relation to individual roosts lost the following key factors will be considered:

- type of roost
- species;
- likely sensitivity to disturbance;
- risk of train strike during operation (including risk of drawing more bats close to the line through the provision of roosting provision in proximity to the Proposed Scheme);
- nature of surrounding habitat;
- likely or known pattern of dispersal within the habitat;
- proposed planting scheme; and
- design of the proposed scheme in this area (e.g. is the line in cutting or at grade).

4.2.5 Replacement roosting habitat will be provided in a form and quantum that is most appropriate to the specific location in question. Across the route of the Proposed Scheme it is anticipated that a wide range of replacement roost types will be utilised ranging from the production of bespoke 'bat houses' and hibernation sites, incorporation of roosting habitats into existing structures, the provision of a variety of bat boxes, and the use of tree surgery to provide artificial roosting features within retained trees.

4.2.6 Replacement roosting habitat will be provided both where roosts are lost and where there is considered to be a significant reduction in the available potential roosting resource that could affect the long term status of bat assemblages which occur in the local area. Where the reduction in the available roosting resource has the potential to result in significant adverse effects, compensatory roosting provision will be provided at appropriate levels on a case by case basis. No strict provision ratios are proposed (e.g. 2 bat boxes for each high potential tree lost), and efforts will be made to consolidate roosting provision and ensure a range of compensatory habitat provision is provided, rather than simple deployment of bat boxes only.

## 4.3 Replacement foraging habitat

4.3.1 Habitat losses within the land required for the construction of the Proposed Scheme may require some bats to travel further, and expend more energy during regular foraging and movement throughout their home range for the duration of construction. However, such effects alone (in isolation of those resulting from habitat fragmentation/severance resulting from these losses) are for all species considered unlikely to result in sufficient disturbance of the populations concerned during the period of construction to result in an adverse effect on their conservation status.

4.3.2 Compensatory habitat creation that will be provided to address significant effects on specific habitat types (e.g. ancient semi-natural woodland) will act to prevent any longer term effect on bat populations as a consequence of the losses anticipated. Compensatory habitats to be created will include a range of new woodland, grassland, and water bodies.

4.3.3 No mitigation/compensatory planting will be provided with the primary aim of addressing losses of bat foraging habitat since planting to be provided to address other significant effects will act to fulfil this function. Where there is particular benefit in doing so, the final planting scheme and maintenance regime will, whilst taking account of the multiple functions of such areas, incorporate details that maximises the value of these habitat features in relation to bats (e.g. through scalloping woodland edges to provide sheltered areas that will support concentrations of insects and promote bat foraging).

## 4.4 Mitigating for habitat fragmentation/severance (construction)

4.4.1 The removal or disturbance of habitat features that are utilised by bats during breeding, hibernation or during seasonal migrations between roosts (e.g. moving from hibernation to maternity roost locations) have the potential to result in adverse effects on the bat populations or assemblages during construction. However, the point at which such impacts are likely to result in a significant adverse effect on the

conservation status of the population concerned will differ dependent on the status and behaviour of the species concerned. As such the requirement for mitigation measures to address the effects of habitat fragmentation/severance arising as a result of construction will be considered based on both the species and its conservation status.

4.4.2 Where habitat severance/fragmentation arising as a result of construction is identified as having the potential to result in an adverse effect on bat populations the nominated undertaker will seek (wherever it is reasonably practical to do so) to minimise its effects through:

- influencing the construction programme (where reasonably practicable to do so) in order to ensure works are sensitively seasonally timed in order to minimise impacts;
- retaining key habitat elements that are demonstrated to be of significant value for the movement of bats through the landscape for as long as possible during construction, giving time for replacement linear features to become established and minimising disruption to ecological functionality (e.g. construction of a new over-bridge in parallel with one known to be utilised by bats crossing the existing railway line in order to minimise disruption);
- implement replacement habitat creation/restoration as early as is reasonably practical to do so in project programme, in order to minimise the duration and scale of habitat fragmentation/severance effects;
- use of measures such as 'artificial hedgerows', wattle screens or other artificial measures to provide linear flight lines of use to bats during construction and until such point that planting is sufficiently established to fulfil this function;
- reinstating suitable hedgerows on the route of known existing flight lines and increasing the connectivity with other known areas of suitable habitat in the wider landscape; and
- avoiding night time working in proximity to key commuting/foraging features.

## 4.5 Minimising disturbance of roosts during construction

4.5.1 During the construction phase the following mitigation measures will (wherever it is reasonably practicable to do so) be implemented in order to prevent the disturbance of retained roosts:

- avoiding night-time working in proximity to known roosts;
- security lighting to be directed away from roost entrances; and
- timing of activities which could result in disturbance of known roosts to be controlled and wherever possible to be conducted during the times of the year when bats would not be present, e.g. October to April inclusive for maternity roosts.

4.5.2 Where this guidance cannot be followed and the proposed works are likely to cause disturbance, a licence will be sought from Natural England.

## 4.6 Minimising risk of collisions with trains/vortices during operation

4.6.1 The potential for the operation of the Proposed Scheme to result in adverse effects on bats as a consequence of train strike and associated vortices will be considered for each location on a species by species basis taking into account the following factors:

- flight habit and preference;
- position within geographical range of the species;
- conservation status; and
- baseline information on activity of the population concerned.

4.6.2 Where there is considered to the potential for an adverse effect on the conservation status of the bat species concerned then the following measures will (where reasonably practicable to do so) be utilised to ensure there is no long term effect on the favourable conservation status of the species concerned:

- provision of green bridges, underpasses and culverts, or the enhancement or 'greening' of existing structures in order to facilitate passage of bats across the route;
- where the above features are required efforts will be made to include these early in the construction programme in order to maximise the time available for the establishment of associated landscaping;
- use of planting to create 'hop-overs' at key locations where bats are known to be at risk when crossing the route of the Proposed Scheme;
- provision of new planting to 'funnel' bats to the new crossing points, and the use of artificial measures (e.g. wattle screens) on a temporary basis until establishment of planting, in order to facilitate use of the above features;
- planting to strengthen existing alternative flight routes through the wider landscape that are sufficiently separated from the effects of disturbance or vortices associated with the operational railway;
- degradation and removal of some existing vegetation in proximity to the route of the Proposed Scheme in order to reduce the suitability of habitats for foraging bats in areas of high risk for sensitive species; and
- avoiding operational lighting close to proposed bat crossing points and, conversely, using lighting in other locations in order to direct bats to cross the route at proposed bat crossing points.

4.6.3 Mitigation/compensation provision will be provided at a level appropriate to ensure that by the commencement of operation likely effects are reduced to a level where any killing/injury through train strike and/or the effects of turbulence will be sufficiently low to have confidence that there will be no detrimental effect on the favourable conservation status of the species concerned. As such the level and form of mitigation/compensation required will differ between species based on the status of the populations concerned.

## 4.7 Management, maintenance and monitoring

4.7.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of mitigation features and compensatory habitat provision.

4.7.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed in consultation with key statutory bodies, and will form part of the EMR agreed at Royal Assent.

4.7.3 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

# 5 Otter

## 5.1 Key principles

5.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any long term adverse effect on the FCS of otter populations in the vicinity of the route of the Proposed Scheme.

5.1.2 The nominated undertaker will seek to provide safe passage for otter across the route of the Proposed Scheme throughout construction and during operation. This commitment will apply to all points at where the Proposed Scheme crosses watercourses that are either known to be utilised by otter, or are considered to have the potential to be utilised by otter in the future. This commitment acknowledges the on-going expansion of otter populations across the UK that is likely to continue during construction and into the period of operation of the Proposed Scheme.

5.1.3 Where works are likely to cause disturbance of otter or interference or damage to a holt a EPSM licence will be sought from Natural England.

## 5.2 Provision of replacement holts

5.2.1 Loss of otter holts has the potential to result in an adverse effect on FCS of the population concerned. Where the loss of holts cannot be avoided then the nominated undertaker will seek to mitigate adverse effects on the FCS of the populations concerned by creating artificial holts.

5.2.2 Replacement provision will seek to maximise the quality and likelihood of use of an artificial holt, in accordance with the following key principles:

- provision of two new artificial holts for every one lost;
- artificial holts will be sited in an undisturbed area, free from flooding and close to a good supply of food;
- where reasonably practicable to do so, one of the replacement holts will be provided in close proximity to the original holt that was lost when construction in the vicinity is complete. The other will be provided in a nearby area of suitable habitat that will not be subject to disturbance during the period of construction;
- design of replacement holts will seek to replicate the form and complexity of the holt lost, ranging from simple log piles with entrance points, to more complex structures consisting of pipes and engineered cavities;
- artificial holt will be located on the same watercourse as the holt to be lost; and
- artificial holts will be created at least 12 months in advance of scheduled holt loss in order to given otter time to investigate and become acclimatised to the artificial holts.

5.2.3 The design and siting of artificial holts, alongside the methodology for excluding otters from existing holts will be co-ordinated by a consultant with experience in mitigation design for otters.

## 5.3 Mitigating disturbance during construction

5.3.1 Where watercourses known to support otter cross the route of the Proposed Scheme there is the potential for disturbance, killing and injury of otter. This will be avoided through implementing the following principles (wherever it is reasonably practicable to do so) at those locations where otters are known to be present:

- avoiding lighting of watercourses known to be utilised by otter through directing lights away from the watercourse and any associated holt locations;
- avoiding placement of site compounds in close proximity to watercourses;
- using fencing to guide otters to temporary safe crossing points for the duration of construction works or watercourse realignment works;
- providing a safe means by which otter can safely escape any deep excavations in the vicinity of suitable watercourses;
- securing chemicals and machinery overnight when working near watercourses; and
- limiting noise and vibration in the vicinity of retained known holts.

## 5.4 Maintaining safe passage

5.4.1 Design will aim to ensure that where the route of the Proposed Scheme crosses watercourses which support otter (or are potentially suitable to do so in the future) a means of safe passage for otter will be maintained.

5.4.2 All culverts will be designed to be suitable to allow passage for mammals such as otter and water vole, taking into account flood events, or will have an alternative dry tunnel installed.

5.4.3 Mammal proof fencing in line with the specification provided in the Design Manual for Roads and Bridges (Highways Agency, 1999)[9] will be provided in association with crossing points wherever deemed necessary to ensure their effectiveness, and where necessary to prevent otters gaining access to the active railway line.

## 5.5 Management, maintenance and monitoring

5.5.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of mitigation features and compensatory habitat provision.

5.5.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed in consultation with key statutory bodies, and will form part of the EMR agreed at Royal Assent.

[9] Highways Agency (2001). *Design Manual for Roads and Bridges. Volume 10 Environmental design. Section 4 - Nature Conservation. Part 4 HA81/99 Nature Conservation advise in relation to otters*. Her Majesty's Stationery Office.

5.5.3 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

# 6 Hazel dormouse

## 6.1 Key principles

6.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any long term adverse effect on the FCS of populations of hazel dormouse in the vicinity of the route of the Proposed Scheme.

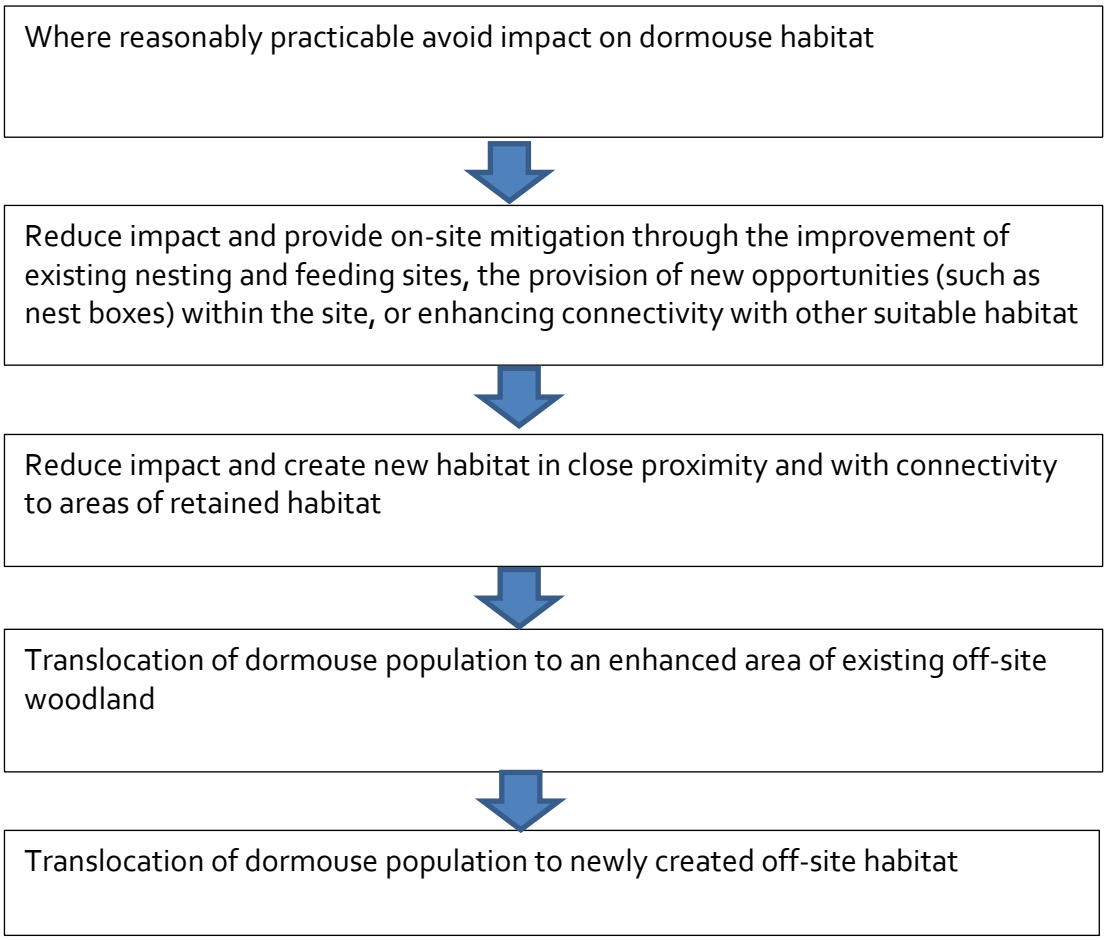
6.1.2 Surveys conducted in support of Phase 1 have yet to identify any signs to indicate that dormouse is present within land required for the construction of the Proposed Scheme. As a consequence it is considered likely that no mitigation or compensation will be required in relation to dormouse.

6.1.3 However, as access refusals have prevented access to some areas of potentially suitable habitat, it is not yet possible to confirm that dormouse is absent. As a consequence the following principles of mitigation are provided to demonstrate how the nominated undertaker would seek to mitigate and/or compensate for any effects on dormouse arising from the construction of the Proposed Scheme, if they are found to be present.

6.1.4 In line with the approach advocated in Bright *et al* (2006)[10] the mitigation hierarchy in Figure 2 will be applied.

[10] Bright, P., Morris, P., and Mitchell-Jones, T. (2006). *Dormouse Conservation Handbook- Second Edition.* English Nature, Peterborough.

Figure 2: Mitigation hierarchy for hazel dormouse




## 6.2 Terrestrial habitat creation and/or enhancement

6.2.1 Where dormouse are confirmed to be present and the Proposed Scheme will result in losses of suitable habitat the nominated undertaker will act to ensure that these losses do not result in a detrimental effect on the FCS of the population concerned through providing replacement habitat. This may be achieved through either creation of new habitat or the enhancement of existing habitat to increase its potential value for dormouse.

6.2.2 Where reasonably practicable the enhancement of existing woodland areas to make them more suitable for use by dormouse will be favoured, in order to reduce the lag-period until these areas reach their target condition. Both habitat creation and enhancement will be undertaken with the aim of seeking to create habitats that meet the majority of the following criteria:

- a diverse, unshaded and productive understorey, preferably dominated by hazel, and including a range of other suitable plants to provide food sources and suitable nesting material;
- good connectivity to other areas of suitable habitat through either links to existing woodland or wide hedgerow connections;
- good arboreal connectivity;
- mixed age range of trees; and

- species rich edge strips or ride sides.

6.2.3 Where existing habitat is to be subject to works to increase its suitability to support dormouse then the nominated undertaker will also provide an appropriate number of nest boxes within suitable habitat to augment the availability of suitable habitat.

6.2.4 Where habitat creation or enhancement is necessary to compensate for the loss of habitat supporting dormice this new habitat must be of greater value and size than that of the area previously lost.

6.2.5 Where reasonably practicable replacement habitat will be provided in locations that maintain connectivity with retained elements already utilised by the populations affected (i.e. in-situ).

6.2.6 The construction schedule will ensure that where habitat is to be lost then any associated restoration/enhancement of woodlands will be conducted at least 12months prior to translocation in order to allow the plant and invertebrate populations to establish.

6.2.7 Where new habitat is created then the period until such habitats are suitable for use for dormice will depend on the nature of the adjoining habitat, and the method of habitat creation. This may require a lead in period of several years. Where habitat supporting dormice is to be lost, mature trees and shrubs, in particular hazel coppice stools will (where reasonable and practicable to do so) be translocated and used to speed up the establishment of new habitats.

## 6.3 Capture/exclusion and persuasion/displacement

6.3.1 Where areas of existing dormouse habitat are affected there will be a need to clear dormouse from this area prior to commencement of construction.

6.3.2 Where enhanced or new habitat is provided that has connectivity with the areas affected then efforts will be made to persuade dormice to move into newly created habitats. For small to medium sized habitat areas progressive vegetation removal will be used to encourage this, making use of appropriate seasonal windows for undertaking such activities.

6.3.3 Where utilised persuasion/habitat degradation will be conducted in accordance with the following key principles (Bright *et al*, 2006):

- clearance should be progressive wherever it is reasonably practicable to do so;
- where reasonably practicable to do so all clearance should be undertaken using hand tools only in line with best practice guidelines. In all cases clearance work should be attended by a suitably qualified ecologist;
- each clearance strip should be narrower than the radius of a typical home range for that habitat (an average of 50m);
- for an area of up to one dormouse home range (approximately one to 1.5 ha of woodland 300m of edge) clearance of bushy vegetation and tree felling in winter (November to March) is recommended as the least damaging option;

- clearance should be planned as a two-stage operation, with removal of surface vegetation in winter (November to March) followed by progressive stump extraction and earth removal in the following summer during periods where dormice are active, and able to respond immediately (i.e. taking into account breeding and presence of dependent young); and
- for small areas (e.g. less than 50m2 of high quality woodland, larger areas of low quality woodland and short lengths of hedge (Natural England (undated) Standing Advice)[11] small amounts should be taken out each day during the active period to allow animals time to escape and a search should be made for nests; the best periods for this work are May and late September when the presence of young is less likely.

6.3.4 Where large areas of habitat are to be lost, or compensatory habitat will be provided at an off-site receptor with no connectivity to the area affected then translocation will be necessary. If required, translocation will be conducted in accordance with best practice guidelines (Bright *et al*, 2006), which includes the requirement for undertaking appropriate disease risk analysis prior to translocation.

6.3.5 In all cases where areas of dormouse habitat are affected dormice nest boxes will be erected within the receiving area at a density of 20 to 25 boxes per hectare. These measures will increase carrying capacity and provide safe shelter.

## 6.4 Maintaining habitat connectivity

6.4.1 Where severance is identified as having the potential to result in an adverse effect on conservation status of the population concerned the nominated undertaker will seek to minimise its effects. This will be through implementing habitat creation/restoration to increase connectivity with other known areas of suitable habitat in the landscape, and maintain the viability of these severed elements, for example by providing new woodland links and hedgerows. Use of a green bridge would be considered if all other options for maintaining FCS of the population concerned have been exhausted.

## 6.5 Mitigation, monitoring and management

6.5.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of mitigation features and compensatory habitat provision.

6.5.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed in consultation with key statutory bodies, and will form part of the EMR agreed at Royal Assent.

6.5.3 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

[11] Natural England (undated). Standing Advice Species Sheet: Hazel Dormice. http://www.naturalengland.org.uk/Images/Dormice_tcm6-21704.pdf. Accessed on 21/09/13

# 7 Badgers

## 7.1 Key principles

7.1.1 The nominated undertaker will ensure that mitigation and compensation provided for badger populations affected by the proposed scheme will avoid significant adverse effects.

7.1.2 The nominated undertaker will provide compensation for the loss of main and annex setts and seek to maintain safe passage for badgers across the route of the Proposed Scheme.

7.1.3 Due to the limited legal protection afforded to badger and its widespread nature throughout the route of the Proposed Scheme, mitigation/compensation for the effects of habitat severance will only be provided where there it is clear that in the absence of its provision a legal offence would occur.

## 7.2 Creation of artificial setts

7.2.1 Where main or annex setts are to be lost as a consequence of works associated with the construction of the Proposed Scheme the nominated undertaker will provide an artificial sett.

7.2.2 As far as is reasonably practicable artificial setts will be provided in locations that maintain connectivity with retained setts, key foraging areas and well used paths utilised by the badgers affected. Artificial setts will be constructed to include chambers and tunnels and will aim to replicate as much as possible the characteristics of the natural setts they replace. In all cases replacement setts will be provided within the appropriate social group territory.

7.2.3 Artificial setts will be created at least 6 months prior to closures of the setts they replace in order to provide some time to allow badgers to investigate and become acclimatised to the artificial sett. Baiting will be conducted periodically following the construction of the new sett, up to the point of closure of the existing sett, in order to encourage the badgers to locate and begin to utilise the new sett.

7.2.4 Artificial setts will be positioned in suitable locations to ensure that there will be sufficient drainage to avoid flooding and planted to ensure cover and lack of disturbance.

7.2.5 When siting new setts those locations which are subject to high levels of human or animal disturbance will be avoided.

7.2.6 Where the proposed works are likely to cause sett interference a licence to disturb a badger sett will be sought from Natural England.

## 7.3 Loss of habitat - maintaining safe passage across the route of the Proposed Scheme

7.3.1 No specific habitat creation for badger will be undertaken. Losses in habitats that were suitable for use by badger prior to construction will be addressed through compensation provided to address wider habitat loss as a consequence of the Proposed Scheme. This will provide large areas of woodland and grassland which will

within 5 years (fewer in some cases) become suitable to provide replacement habitat for badger.

7.3.2 Where the territory of a social group will be severed to the extent that it may result in a significant adverse effect on the conservation status of the population concerned then the use of measures to maintain safe passage of badger across the route of the Proposed Scheme will be explored. Where significant effects are anticipated then the effects of habitat severance and fragmentation will be minimised by the installation of appropriately designed and positioned passageways beneath or over the railway.

7.3.3 Where badger tunnels are provided then the following features will be considered:

- siting tunnel on or near a known badger path wherever it is practical to do so;
- good habitat connectivity with existing landscape features such as hedges; and ditches:
- good vegetation cover around the tunnel entrance;
- ensuring adequate drainage is incorporated into the design; and
- tunnel diameter of at least 600mm.

## 7.4 Mitigating effects arising during the construction of the Proposed Scheme

7.4.1 During the construction phase, activities that may pose a temporary threat to badgers or disturb them whilst they are in nearby setts will be controlled. These will include some or all of the following:

- security lighting to be directed away from setts;
- chemicals to be stored as far away from setts and badger paths as possible;
- trenches to be covered at the end of each working day, or to include a means of escape from the animal falling in,
- water sources for badgers to be safeguarded;
- trees to be felled away from setts and must not block badger paths; and
- disturbances such as loud noise or vibration that might agitate badgers occupying a sett to be avoided or limited to areas well away from setts.

## 7.5 Management, maintenance and monitoring

7.5.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.

7.5.2 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

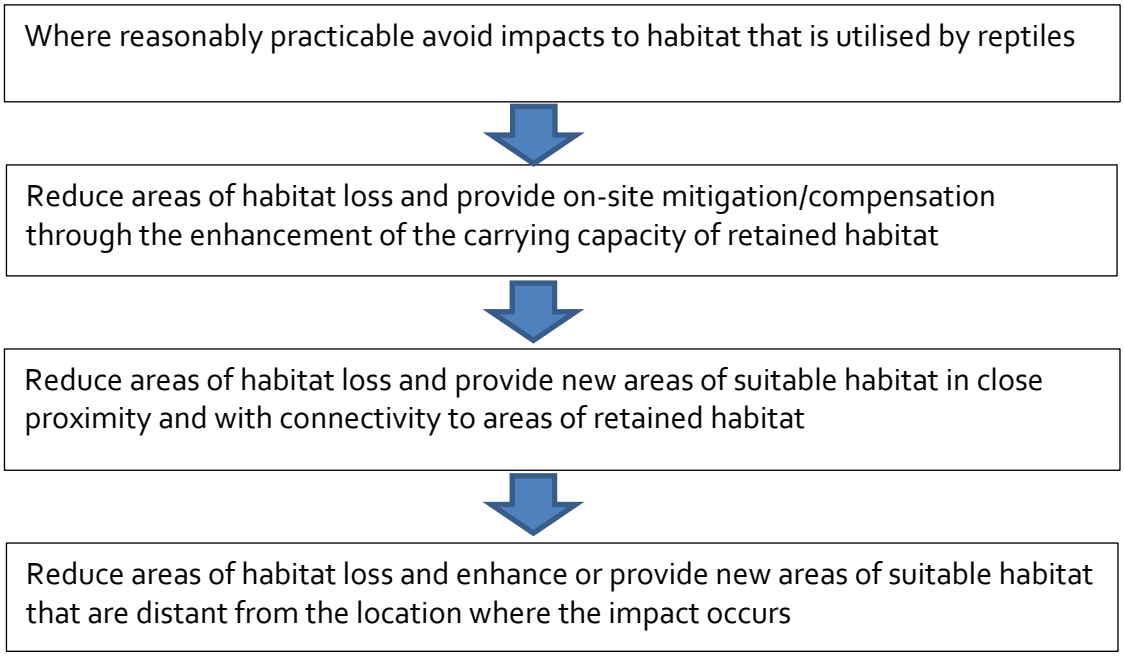
# 8 Reptiles

## 8.1 Key Principles

8.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any long term adverse effect on the conservation status of populations of common reptile (slow worm, adder, grass snake and sand lizard) in the vicinity of the route of the Proposed Scheme.

8.1.2 In addressing the potential loss of areas of habitat known to be used by common reptiles, the mitigation hierarchy, shown in Figure 3, will be applied:

Figure 3: Mitigation hierarchy for habitat utilised by reptiles




8.1.3 Where translocation will involve movement of individuals to locations outside of the normal extent of that population then disease screening will be undertaken in line with current best practice to ensure that all populations involved are free from disease at time of translocation.

8.1.4 Once constructed the railway is for the majority of the route considered unlikely to form an absolute barrier to reptile movement. Reptiles are known to utilise habitats that are common to operational railway corridors such as south facing embankments for basking.

8.1.5 Where severance is identified as having the potential to result in an adverse effect on conservation status the nominated undertaker will seek to minimise its effects through implementing habitat creation/restoration to increase connectivity with other known areas of suitable habitat in the landscape and maintain the viability of these severed elements.

8.1.6 The use of reptile tunnels as a potential method for addressing the effects of severance has been rejected on the basis of a lack of clear evidence demonstrating their effectiveness.

## 8.2 Creation of replacement habitat

8.2.1 Where a significant adverse effect on common reptiles will occur then the nominated undertaker will act to provide sufficient replacement habitat to ensure the conservation status of the population is maintained in the long term.

8.2.2 No adherence to a strict ratio for balancing losses to gains is proposed. Consideration of the extent of terrestrial habitat required to address losses as a consequence of the Proposed Scheme will be undertaken by an experienced ecologist and will take into account both the habitat area and quality that is to be provided.

8.2.3 Where replacement habitat is of equal quality to those areas lost then the area of replacement provision will be at least as large as the area lost (i.e. minimum of 1:1 ratio).

8.2.4 Where it is not reasonably practicable to mitigate the impact on the local population in-situ then opportunities will be taken to consolidate compensation provision as part of larger scale habitat creation areas. All such compensation areas would be provided (where reasonably practicable to do so) in close proximity to the route, through the creation of high quality areas of terrestrial habitat, integrated with mitigation/compensation provision for other species.

8.2.5 Habitats of similar type to those that will be lost will be provided and bunds, hibernacula and other above ground refugia will be provided in each area of terrestrial habitat creation in order to maximise their potential carrying capacity.

8.2.6 Planting of terrestrial compensation areas will utilise species appropriate to the local area, and where possible will seek to maximise the value of such areas for other species, without compromising their value for reptiles.

8.2.7 All hibernacula, bunds and other refugia incorporated into the final design will be constructed in accordance with current best practice guidelines (e.g. Herpetofauna Workers Manual, Gent and Gibson 2003)[12].

## 8.3 Capture, exclusion and habitat manipulation

8.3.1 Where areas of habitat loss are limited and compensation will be provided within areas with direct connectivity to the areas lost then (where reasonably practicable to do) progressive degrading of the habitat to be lost will be conducted in order to encourage reptiles to move into new habitats. The requirement for additional capture and exclusion to augment this process will be considered on a case by case basis taking into consideration the population size, habitat quality and complexity of habitats concerned.

8.3.2 Where required capture and exclusion will be undertaken in accordance with the current best practice guidelines at the time of construction.

8.3.3 Wherever it is reasonably practicable to do so translocation will commence a minimum of 12 months prior to the required start of construction. For complex sites supporting high population size classes then a longer lead in period may be necessary in order to ensure the site is cleared prior to construction.

[12] Gent, T. and Gibson, S. (2003). *Herpetofauna Workers Manual*. Joint Nature Conservation Committee.Peterborough.

8.3.4 Exclusion fencing will be maintained for the duration of construction at those locations where there is considered to be a risk of reptiles re-entering construction areas post habitat clearance.

8.3.5 Permanent exclusion fencing will be provided in those locations where the operation of the scheme represents a significant risk to reptile populations or where the presence of reptiles within key areas of operational infrastructure have the potential to significantly constrain operational requirements.

## 8.4 Management, maintenance and monitoring

8.4.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.

8.4.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.

8.4.3 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

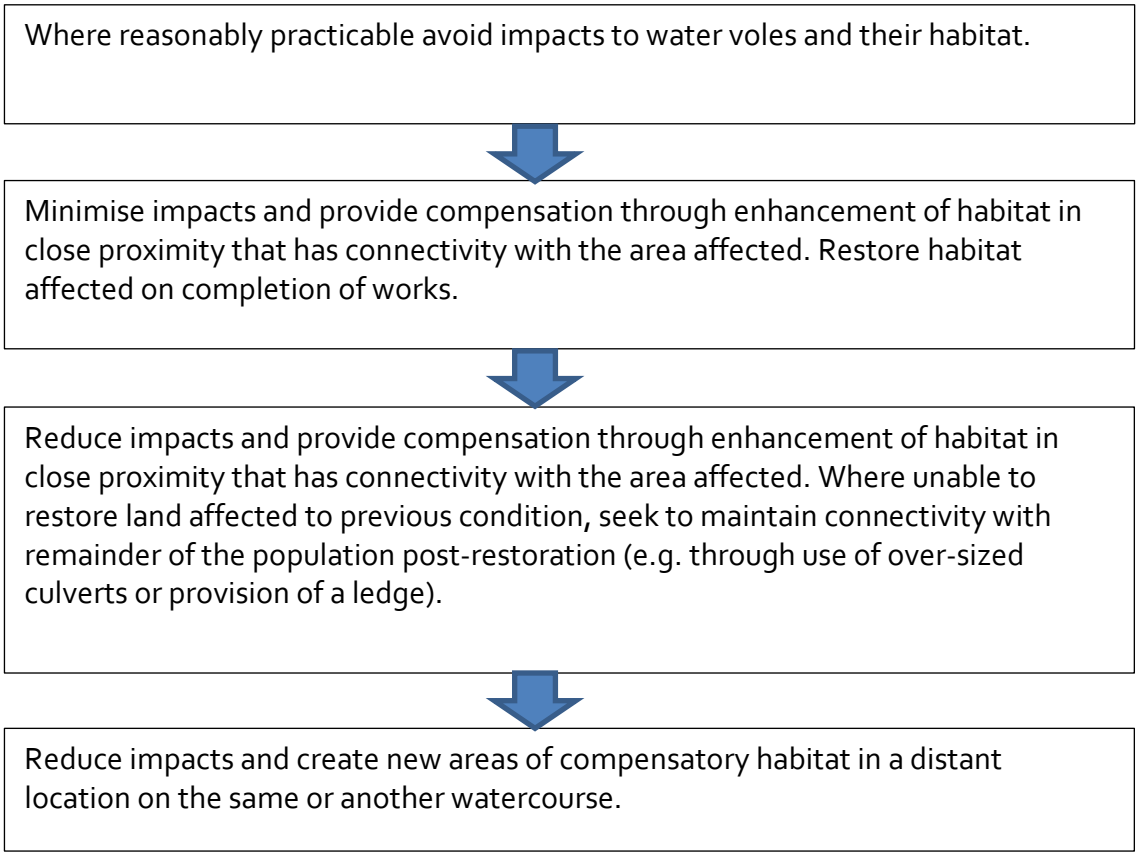
# 9 Water vole

## 9.1 Key principles

9.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any significant effects on the conservation status of water vole populations in the vicinity of the Proposed Route.

9.1.2 The nominated undertaker will mitigate for effects on water vole by applying the following mitigation hierarchy, as described in The Water Vole Conservation Handbook (Strachan *et al*, 2011)[13]:

Figure 4: Mitigation hierarchy for water vole




9.1.3 Where it is not reasonably practicable to mitigate the impact on the local population in-situ then opportunities will be taken to consolidate compensation provision as part of larger scale habitat creation areas. All such compensation areas would (where reasonably practicable to do so) be provided in close proximity to the route, through the creation of areas of suitable bank and riparian habitat.

## 9.2 Provision of replacement habitat

9.2.1 Wherever reasonably practicable to do so the undertaker will compensate for the loss and/or disturbance of existing water vole habitat through the creation of replacement habitat of a similar quantity and quality. This may be achieved either through the

[13] Strachan, R., Moorhouse, T., and Geling, M. (2011). *Water Vole Conservation Handbook - Third Edition.* Wildlife Conservation Research Unit, Abington.

enhancement of existing habitat within the same or linked watercourses, or through the creation of new habitat.

9.2.2 Replacement habitat will be provided as close to the area affected as it is reasonably practicable to do so.

9.2.3 Where it is reasonably practicable to restore the habitats which are to be affected during construction then this will be conducted as soon as possible following the completion of construction.

9.2.4 Where enhancement of existing habitats is proposed and there is likely to be seasonal use then such enhancements works that are required will be undertaken outside of this season in order to avoid potential killing or injury of individuals.

9.2.5 Where replacement habitat or improvement of existing habitat is undertaken then these works will be undertaken prior to the removal of the habitat to be affected by construction. Wherever it is reasonably practicable to do so new habitats will be created at least 12 months in advance of the proposed translocation in order to allow the new areas of habitat to establish.

## 9.3 Capture, exclusion and habitat manipulation/displacement

9.3.1 The most appropriate method for clearing water voles from areas to be affected by the proposed works will be considered on a site by site basis taking into account the following factors:

- size of habitat area affected;
- likely number of individuals;
- seasonal timing of the works; and
- proposed method of providing mitigation/compensation as defined by the output of the mitigation hierarchy above.

9.3.2 Where it is reasonably practicable to do so, habitat manipulation will be used to encourage the displacement of individuals to areas of suitable retained or enhanced habitat in adjoining sections of the same watercourse through progressive removal of bankside vegetation. Use of displacement will be favoured where the area affected is limited in extent and is only likely to support a relatively small number of animals. Where utilised, habitat manipulation will be conducted in accordance with the best practice guidelines provided in *Water Vole Conservation Handbook* (Strachan *et al*, 2011).

9.3.3 Where displacement is considered unsuitable based on consideration of the factors identified in paragraph 9.3.1, trapping of water voles will be undertaken in accordance with the guidelines provided in *Water Vole Conservation Handbook* (Strachan *et al*, 2011) and Natural England (undated) Standing Advice Species Sheet: water voles[14].

9.3.4 Where translocation to a site distant to the area affected is proposed and there is the potential for interaction of a previously isolated population, appropriate disease

[14] Natural England (undated) *Standing Advise Species Sheet: water vole.* http://www.naturalengalnd.org.uk/Images/WaterVoles_tcm6-21714.pdf. Accessed on 21/09/2013

screening will be conducted prior to commencement of the full scale capture and release programme.

9.3.5 In some circumstances where it is not appropriate to translocate the population or to encourage the use of adjacent habitats, it may be necessary to take voles into a captive breeding programme. This approach may be suitable where it is possible to return water voles to their original location following the completion of temporary works, but no options for displacement or off-site translocation are viable. In addition captive breeding may be appropriate where the trapped population is of limited size and therefore will be of increased risk of detrimental effect from the pressures of immediate translocation. Where this is necessary captive breeding will be undertaken by those experienced and qualified to do so, in order to build up the number of voles to a level where it is considered that the population can be self-sustaining on their release.

## 9.4 Minimising effects of habitat fragmentation

9.4.1 Wherever it is reasonably practicable to do so the nominated undertaker will seek to ensure that the construction of the Proposed Scheme avoids fragmentation of water vole habitat, which has the potential to result in adverse effects on the functioning of the water vole population of the wider local area.

9.4.2 The potential for fragmentation will be considered during mitigation design. In extreme situations where it is not reasonably practicable to maintain the viability of severed fragments of a population affected by the Proposed Scheme then the nominated undertaker will consider the trapping of water voles from isolated fragments of habitat outside the extent of Proposed Scheme in order to allow the full population to be relocated to the same receptor site, and maintain its viability in the long term.

9.4.3 All culverts will be designed to be suitable to allow passage for mammals such as otter and water vole, taking into account flood events, or will have an alternative dry tunnel installed.

### Management, maintenance and monitoring

9.4.4 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.

9.4.5 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.

9.4.6 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

# 10 White clawed crayfish

## 10.1 Key principles

10.1.1 The nominated undertaker will ensure that impacts as a consequence of the Proposed Scheme do not result in any long term significant adverse effects on the conservation status of white clawed crayfish populations in the vicinity of the Proposed Scheme.

10.1.2 Where it is reasonably practicable to do so, bank and channel works will be conducted in small sections, with progressive reinstatement to limit the reduction in the availability of suitable habitat. In addition measures will be implemented to prevent siltation and pollution of watercourses.

10.1.3 Where it is necessary to conduct works in areas where white clawed crayfish are confirmed to be present, the nominated undertaker will seek to provide replacement suitable habitat in close proximity to the areas of habitat affected (within a few hundred metres) and within sections of the same watercourse (or tributaries of it) that are already used by individuals of the same population. Such provision will be made in advance of the proposed works, allowing any crayfish captured during clearance works to be released into these locations. In doing so the aim will be to avoid any long term effect on the conservation status of the population concerned.

### Capture and exclusion

10.1.4 Where required crayfish removals will consist of a combination of both trapping and destructive searching of potential refuges prior to construction, and controlled draw-down under ecological supervision. Works would be conducted according to the key principles identified in Peay (2000)[15] which include the following:

- undertaking trapping and destructive clearance of refuges immediately in advance of the proposed works;
- retention of stones suitable for use during restoration;
- where possible erect a temporary barrier to prevent access from adjoining sections of the channel which are not subject to works;
- ecological supervision throughout draw-down to catch crayfish as they emerge from refuges;
- destructive clearance of all structures and habitats suitable for possible use by crayfish on completion of draw-down; and
- relocate crayfish to identified receptor site as soon as reasonably practicable.

10.1.5 Exclusion of crayfish from construction areas will be conducted during the suitable seasonal windows of either April or from July to October inclusive (Natural England, undated)[16]. Current best practice guidance for disease screening and biosecurity will be implemented at all times.

[15] Peay, S. (2002). *Guidance on Habitat for White Clawed Crayfish and its restoration.* Environment Agency Technical Report W1-067/T.
[16] Natural England (undated). Standing Advice Species Sheet: White Clawed Crayfish. http://www.naturalengland.org.uk/Images/Crayfish_tcm6-21618.pdf Accessed on 21/09/2013

## Aquatic habitat creation and restoration

10.1.6 Where an adverse effect is anticipated on white clawed crayfish then the requirement for creation of replacement habitat in close proximity on the same watercourse will be considered, in order to provide an appropriate receptor site.

10.1.7 Where enhancement of existing habitat is undertaken this will seek to achieve the following in order to provide suitable habitat to support crayfish:

- improved water quality;
- reduced siltation;
- increased refuge availability;
- removal of any alien crayfish; and
- more appropriate type and structure of aquatic and bankside vegetation.

10.1.8 All enhancement works will be completed prior to the commencement of the clearance of affected habitat. Suitable measures for each location where such works are required would be agreed in conjunction with Natural England and the Environment Agency prior to the commencement of construction.

10.1.9 Where additional refuges are provided these will be of sizes to support both adults and juveniles, and may be provided through a variety of measures including provision of stone on the bed or in banks; engineering suitable crevices into below water man-made structures; and additional wood or vegetation along the banks.

10.1.10 Once construction works have been completed, where compatible with the design and operation of the Proposed Scheme, areas of habitat affected by the construction of the Proposed Scheme will be reinstated so that the bank and channel are suitable for white clawed crayfish.

10.1.11 If the use of an 'ark site' is deemed necessary, then a suitable site will be selected in consultation with relevant consultees in accordance with the guidance provided in Ark sites for white clawed crayfish - guidance for the aggregates industry (Whitehouse *et al* 2009)[17].

## Avoiding and mitigating effects during construction phase

10.1.12 During the construction phase where white clawed crayfish are known to be present the following measures will be implemented as appropriate with the aim of avoiding or mitigating adverse effects which could occur during construction:

- security lighting to be directed away from riverbanks and watercourses;
- chemicals to be stored as far away from watercourses as possible;
- monitoring to ensure no adverse siltation of downstream locations;
- reducing disturbance to riverbank;
- maintaining existing water levels and water flow; and

[17] Whitehouse, A.T., Peay, S. and Kindemba, V. (2009). *Ark sites for White-Clawed Crayfish - Guidance for the aggregates industry*. Buglife - The invertebrate Conservation Trust, Peterborough.

- reducing removal of bankside vegetation and trees.

## 10.2 Management, maintenance and monitoring

10.2.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.

10.2.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.

10.2.3 Detailed management, maintenance and monitoring strategies for individual locations will be provided alongside derogation licence applications post Royal Assent.

# 11 Fish

## 11.1 Key principles

11.1.1 The nominated undertaker will ensure that mitigation and compensation provided for fish populations affected by the proposed scheme will seek to ensure no permanent significant adverse effects occur.

11.1.2 The extent of areas affected by culverts, watercourse realignment and dewatering will be reduced as far as reasonably practicable. In addition, where reasonably practicable, works will be sensitively timed in order to minimise impacts on the species concerned.

## 11.2 De-watering

11.2.1 Where dewatering is required to facilitate construction then current best practice methods will be implemented to ensure that all fish from such areas are safely removed and relocated. The capture methodology utilised will take into account the physical features of the water course involved; the species involved; likely numbers; and timing of proposed works. The final methodology will be agreed with the Environment Agency.

11.2.2 Permits will obtained from the Environment Agency for all fish movements undertaken in support of the Proposed Scheme. This process includes the requirement for disease screening.

## 11.3 Fish passage

11.3.1 Where reasonably practicable temporary diversions will be utilised to maintain the safe passage of fish and reduce effects during construction. Where appropriate this may involve the creation of a temporary diversion channel with suitable sized replacement substrate or transplanted substrate from the section being dewatered in order to ensure that the size and flow in the diversion channel replicates the existing channel as closely as possible.

11.3.2 Reinstated watercourses and new alignments will be designed where reasonably practicable to provide habitats of increased complexity and quality.

11.3.3 If potential significant effects on fish populations are identified as a consequence of potential restrictions to fish movement then the potential to provide fish passage will need to be reconsidered. However, no such measures are currently proposed. If required the fish passages will be designed to facilitate the upstream and downstream movement of fish and other aquatic fauna.

## 11.4 Mitigation during construction

11.4.1 During the construction phase activities that may pose a temporary threat to fish (in particular migratory species) or disturb them will be mitigated against. These will include some or all of the following:

- artificial lighting directed away from water surfaces during construction/operation of scheme;

- chemicals to be stored as far away from watercourses as reasonably practicable; and
- activities that may cause pollution and sedimentation will be controlled by approved measures.

## 11.5 Management and maintenance

11.5.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.

11.5.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.

# 12 Invertebrates

## 12.1 Key principles

12.1.1 The nominated undertaker will ensure that mitigation and compensation provided for aquatic and terrestrial invertebrate populations affected by the proposed scheme will ensure no permanent adverse effect on the aquatic and terrestrial invertebrate populations in the vicinity of the Proposed Scheme.

12.1.2 Given the wide range of protected and/or notable invertebrate species it is not possible here to provide specific mitigation principles for all species. Instead broad principles are provided that will apply to the majority of aquatic and terrestrial invertebrate species. In all cases where significant effects are identified then specific mitigation proposals will be developed that reflect the limited ecological niche occupied by many invertebrate species.

12.1.3 Potential significant effects on protected and/or notable species will be reduced by wherever reasonably practicable ensuring that at least some areas of the existing suitable habitat for the species concerned is retained to provide a 'source' to colonise areas of mitigation/compensatory habitat to be provided.

12.1.4 In addition where reasonably practicable to do so, suitable compensatory habitat provided to address significant effects will be created as early as possible within the project programme in order to maximise time available for these areas to establish in advance of losses. Such provision would where reasonably practicable be provided in suitable proximity to allow an element of natural dispersal of the species concerned prior to any habitat loss as a consequence of the Proposed Scheme.

12.1.5 Compensatory habitat provision provided to address significant effects on invertebrates will in general look to mimic the structure and form of the existing nearby habitats which support the population concerned.

12.1.6 Where reasonably practicable to do so some plant material or elements of the areas affected may be transferred to the area of mitigation/compensatory provision in order to increase the likelihood that the target species will occupy the new habitat areas provided (e.g. the transfer of standing dead wood from ancient woodlands to be lost where this habitat element is known to play an important part in the lifecycle of the species concerned; or the transfer of water or aquatic vegetation to speed the establishment of aquatic invertebrate populations in newly created ponds ).

12.1.7 In addition the following measures would be implemented where it is reasonably practicable to do so:

- conducting clearance of affected habitats at an appropriate time of the year based on the life-cycle of the species concerned; and
- retaining elements of suitable habitat for the species concerned as long as reasonably practicable during construction in order to maximise the potential for newly created habitats to become established.

12.1.8 Habitat creation to be provided for other primary purposes (i.e. not specifically to address significant effects on invertebrates) will in the longer term also serve to provide habitat suitable for a range of invertebrate species.

## 12.2 Management and maintenance

12.2.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.

12.2.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.

# 13 Birds

## 13.1 Key principles

13.1.1 The nominated undertaker will ensure that where reasonably practicable the Proposed Scheme will avoid permanent significant adverse effects on birds, including those species listed in Schedule 1 of the Wildlife and Countryside Act (1981 as amended)[18].

13.1.2 Due to the scale and complexity of the Proposed Scheme it will not be feasible to avoid all such impacts and as such mitigation and/or compensation will be provided where in the absence of this provision there is the potential that a significant adverse effect may arise.

13.1.3 Where there is a significant reduction in the availability of nesting or roosting habitat as a consequence of the Proposed Scheme then consideration will be given to the requirement for specific mitigation and or compensation in relation to birds, i.e. in addition to those ecological mitigation/compensation measures that will mitigate impacts on birds population but for which they are not the primary purpose.

13.1.4 Wherever is reasonably and practicable to do so habitat clearance will be conducted outside of the periods where the species or species concerned will be breeding. Through sensitive timing of works it is aimed to reduce disturbance of birds, and the potential for wasted breeding effort.

13.1.5 The loss of potential breeding habitats from within land required for the construction of the Proposed Scheme will as a general rule be addressed in the long term through the replacement habitat provided for landscaping and ecology purposes. Where there is the potential for additional adverse effects to occur prior to these habitats maturing then the option of providing alternative suitable habitat will be considered.

13.1.6 Evidence suggests that mortality of barn owl may result in the loss of all breeding populations of barn owls within 1.5km of the Proposed Scheme. As a consequence to address these losses opportunities to provide barn owl nesting boxes in areas greater than 1.5 km from the route will be explored with local landowners to enhance barn owl populations in existing habitats that would not be affected by the Proposed Scheme.

## 13.2 Management and maintenance

13.2.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.

13.2.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.

[18] Wildlife and Countryside Act (1981) Chapter 69. Her Majesty's Stationery Office, London.

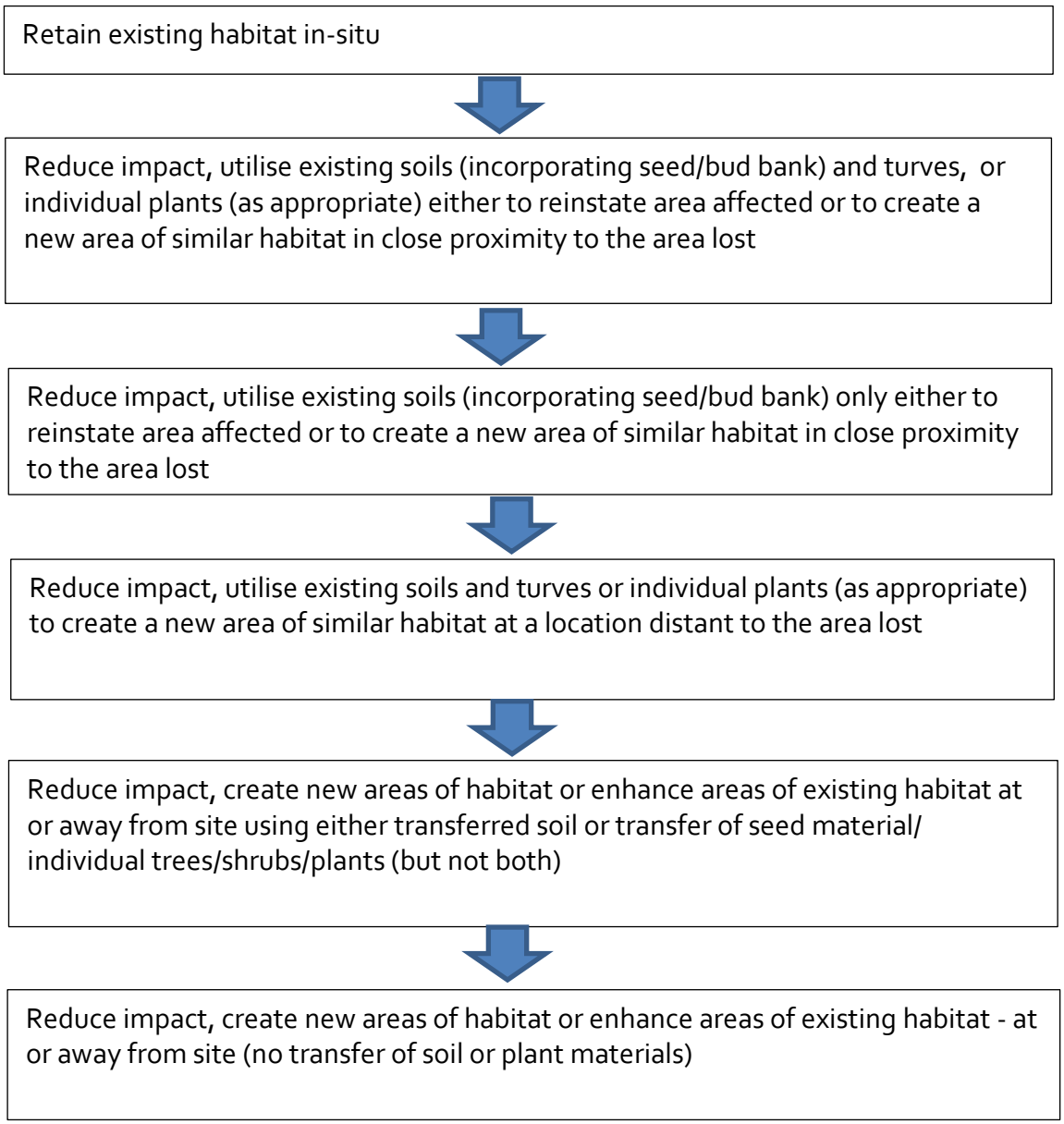
# 14 Habitats

## 14.1 Key principles

14.1.1 The nominated undertaker will seek to ensure that at the route-wide level impacts on habitats as a consequence of the Proposed Scheme will not result in a permanent significant adverse effect on the conservation status of the habitats concerned.

14.1.2 The following mitigation hierarchy will be applied in considering the most suitable approach to mitigating potential habitat loss:

Figure 5: Mitigation hierarchy for habitats




### Translocation

14.1.3 Translocation of habitats is a costly process and does not always provide a habitat that is of higher value than that which can be reached through alternative approaches. As such it would not be reasonable or practical, for example, to undertake translocation of all grassland areas affected by the scheme. As a consequence in the consideration

of the hierarchy for each site the following factors will be considered in deciding at which level in the hierarchy it is most appropriate to provide mitigation/compensation provision:

- ecological value/distinctiveness of habitat type;
- designation status;
- size;
- condition;
- nature of available receptors sites (e.g. topography, drainage, underlying soil type and species composition);
- likely content and condition of the seed bank; and
- ease and speed of recreating a similar habitat type through alternative means.

14.1.4 Where there is the potential for significant adverse effects on habitats of high ecological value then translocation of the affected area may be justified. Where translocation is considered to be justified then it will be necessary to determine the most suitable form of translocation for the habitat type and area concerned. There are four main alternative types of translocation as follows (Anderson 2003[19] and JNCC 2003[20]):

- turf translocation (i.e. where an effort is made partially maintain the integrity of the vegetation layer during the transfer, keeping the vegetation layer and the mass of underlying soil separated);
- soil translocation (where both the soils and the vegetation and scraped up and transferred together with no effort made to separate the two);
- moving trees and shrubs; or
- moving individual plants.

14.1.5 The most appropriate method of compensating for the loss of habitats of ecological value will be considered on a site by site basis taking into account the nature and value of the habitats involved and the financial and other practical implications associated with each of the above methods.

14.1.6 Where translocation is undertaken the turves, soil or plants should be stripped and transferred to the receptor site immediately unless there are clear practical reasons for delay. Storage will increase risk of failure, but where necessary in the short term will be conducted according to best practice guidance (Anderson, 2003).

14.1.7 Detail of proposed translocation strategies for each site will be drawn up by ecologists experienced in works involving the translocation of the habitats concerned, with reference to current best practice guidance (e.g. Anderson, 2003).

[19] Anderson, P. (2003). *Habitat translocation: a best practical guide*. CIRIA, London.
[20] Joint Nature Conservation Committee (2003). *A habitats translocation policy for Britain*. JNCC, Peterborough.

### Receptor sites

14.1.8 When translocating a habitat the process will be dependent upon the suitability of the chosen receptor site. Efforts have been made to select receptor sites that are compatible with the target habitat types concerned based on comparison of the following factors:

- hydrological conditions;
- soil type;
- topography;
- connections to other ecological habitats; and
- size of site; and
- accessibility.

14.1.9 In all cases prior to translocation soil sampling and works to establish ground water levels should be undertaken and used in the detailed design of mitigation areas. In addition in some instances trials may be necessary in order to establish the content and viability of the seed bank.

14.1.10 Where identified receptors sites are not fully compatible with the target community then remedial works will be undertaken to ensure that the surrounding, physical, chemical and hydrological soil and substrate conditions are similar or more suitable than those at the donor site.

## 14.2 Key habitat types

14.2.1 A wide range of habitats will be affected by the Proposed Scheme. Further details are provided here in relation to four key habitat types that will be subject to significant effects as a consequence of the Proposed Scheme. There will be many parallels in the approach adopted for other habitats.

14.2.2 Where it is not reasonably practicable to mitigate the impact of local habitat loss in-situ then opportunities will be taken to consolidate compensation provision as parts of larger scale habitat creation areas. All such compensation areas would be provided in close proximity to the route, where it is reasonably practicable to do so.

### Woodland

14.2.3 Where areas of woodland habitat are affected by the Proposed Scheme the most appropriate form of mitigation has been decided through consideration of the factors identified in paragraph 14.1.3. For woodland areas in particular the consideration of the likely time-lag to establishment and the distinctiveness of the habitat type concerned are likely to be key drivers that mean that translocation is undertaken at some locations.

14.2.4 The nominated undertaker recognises that creation of newly planted woodland and translocation of ancient woodland habitat components cannot be considered as mitigation for these impacts. Ancient woodland in its entirety cannot be translocated and as a consequence it is recognised as irreplaceable within the time frame of the Proposed Scheme.

14.2.5 However, in order to provide compensation in the long term (outside the timeframe of the Proposed Scheme) the translocation of ancient woodland soils will be undertaken. In addition new areas of woodland that will be created will be targeted at providing new areas of habitat of principal importance as defined under Section 41 of the Natural Environment and Rural Communities Act (1996)[21].

14.2.6 Where translocation is identified as being a reasonable and worthwhile approach for the habitat area concerned then for woodlands this may involve implementation of one or more of the following measures, as appropriate:

- soil translocation;
- translocation of veteran trees;
- translocation of coppice stools, and other small trees; and/or
- translocation of fallen or standing deadwood.

14.2.7 Translocation of some or all of the above elements of ancient woodland will enable some of the valuable elements of the existing ancient woodland ecosystems to be retained within the newly created areas.

14.2.8 Soil testing and seed viability trials will be conducted prior to translocation at all locations identified in order to ensure that conditions are suitable.

14.2.9 The nature of wet woodland means that the methods of translocation differ from that for dry woodlands. Where translocation of wet woodland is proposed the mechanisms and logistics of translocation will have particular emphasis on the consideration of the hydrological, hydrochemical and hydrogeological conditions. In addition the gradient of the land and flooding probability will be explored in detail in order to ensure that the donor site is sufficiently inundated to maintain wet woodland habitat.

14.2.10 Woodland translocation should take place in the dormant season in autumn/early winter under normal weather conditions.

14.2.11 Where translocation is not a justifiable option based on the factors identified in paragraph 14.1.3 then new woodland habitat will be created.

14.2.12 In all cases planting will only utilise native species that are characteristic and appropriate to the area concerned. Both areas of new woodland habitat creation, and those translocated should be planted as early as practicable within the project programme.

## Grasslands

14.2.13 Where translocation of grassland areas of high ecological value is justified and reasonably practicable then the most suitable method of translocation (as identified in paragraph 14.1.4) will be considered, taking into account the generic factors identified at paragraph 14.1.3.

14.2.14 The translocation of turves will normally be the preferred option. However, for grassland areas the cohesiveness of the sward will also be taken into account. Turf translocation will not be reasonably practicable where turf contains significant

[21] *Natural Environment and Rural Communities Act (1996) Chapter 16. Her Majesty's Stationery Office, London.*

elements of bare ground or lacks turf cohesiveness (Anderson, 2003). In addition it may not be possible to utilise turf translocation where steep slopes or undulating ground are present.

14.2.15 Where soil translocation is proposed, prior to translocation a selection of seed bank tests will be conducted in order to test the viability and content of the existing seed bank.

14.2.16 Where wet or marshy grassland are to be translocated then specific focus will be given to ensuring that the hydrological regime of the receptor site is manipulated in order that it provides suitable groundwater conditions to support the target habitat in question.

14.2.17 The detailed mechanics of each translocation will be influenced by best practice guidance (e.g. Anderson, 2003) in consultation with experienced ecologists, and contractors experienced in large scale habitat translocation.

14.2.18 Where translocation is not justified or reasonably practicable taking into consideration the factors outlined in paragraph 14.1.3, compensatory grassland will be provided through the preparation and sowing of a suitable area. Such areas will be targeted at providing new areas of habitat of principal importance as defined under Section 41 of the Natural Environment and Rural Communities Act (1996).

14.2.19 In all such cases efforts will be made to ensure that areas identified for provision of grassland habitat creation are compatible with the target community identified. This as a minimum will include consideration of topography, drainage, aspect, and underlying soil type.

14.2.20 Only native species will be utilised and seed mixes will aim to broadly mimic the species composition of those areas to be lost. Where enhancement of the sward is proposed through the provision of a more diverse sward than was present previously only native species which are characteristic to the local area will be utilised. Where reasonable and worthwhile to do so, the collection of seed and/or plants from suitable donor sites will be considered.

14.2.21 Grassland compensation areas will be planted as early as is reasonably practicable within the construction programme in order to allow maximum time for them to establish prior to the losses associated with the Proposed Scheme.

### Heathland

14.2.22 The only areas of heathland that will be affected by the Proposed Scheme are those at Whittington Heath Golf Course Site of Borough Importance (SBI). Based on the ecological value of this habitat and the good chances of success at least some of the areas to be lost will be subject to translocation.

14.2.23 As for grasslands, the method of translocation and detailed mechanics will be devised by experienced ecologists in combination with contractors that have experience in undertaking heathland/acid grassland translocation.

### Hedgerows

14.2.24 The translocation of specific hedgerows will be considered where the age, diversity and structure of these features is such that their loss as individual features will result in

significant adverse effects. In addition translocation of hedgerows may be undertaken where there are benefits for other protected species resulting from reducing the lag time for linear features to establish.

14.2.25 Where justified, translocation will be undertaken according to current best practice guidance, with detailed mechanisms for these works devised by experienced ecologists, in conjunction with contractors that are experienced in undertaking such works.

14.2.26 In order to mitigate for the wider loss of hedgerow habitat, and the associated fragmentation of the existing hedgerow network the undertaker will (where design of the Proposed Scheme and other practical considerations allow) replace those hedgerows which are lost.

14.2.27 Reinstatement will utilise species of native provenance and where reasonably practicable will aim to provide hedgerow networks containing a wider range of appropriate native species than are currently present.

## 14.3 Management and maintenance

14.3.1 The nominated undertaker will commit to appropriate on-going management, maintenance and monitoring of compensatory habitats.

14.3.2 Detail of route-wide commitments to on-going management, maintenance and monitoring will be developed alongside key statutory bodies, and will form part of the EMR agreed at Royal Assent.

# 15 References


Anderson, P. (2003). Habitat translocation: a best practice guide. CIRIA, London.

Bright, P., Morris, P., and Mitchell-Jones, T. (2006). Dormouse Conservation handbook - second edition. English Nature, Peterborough.

English Nature (2001). Great Crested Newt Mitigation Guidelines. English Nature. Peterborough.

Gent. T. and Gibson, S. (2003). Herpetofauna Workers Manual. Joint Nature Conservation Committee. Peterborough.

Highways Agency (2001) Design Manual for Roads and Bridges. Volume 10 Environmental Design. Section 4 - Nature Conservation. Part 4 HA81/99 Nature conservation advice in relation to otters. Her Majesty's Stationery Office Ltd.

Joint Nature Conservation Committee (2003). A habitats translocation policy for Britain.

Joint Nature Conservation Committee (2004 ). Bat Worker's Manual 3rd Edition edited by A.J. Mitchell-Jones and A. P. McLeish

Langton, T.E.S., Beckett, C.L., and Foster, J.P (2001). Great Crested Newt Conservation Handbook, Froglife, Halesworth.

Mitchell-Jones, A.J. (2004). Bat mitigation guidelines. English Nature, Peterborough.

Natural England (2012) *Template for method statement to support application for licence under Regulation 532(2)e in respect of great crested newts Triturus cristatus. Form WML-A14(3) (Version April 2013)*. http://www.naturalengland.org.uk/ourwork/regulation/wildlife/species/greatcrestednewt.aspx. Accessed: 02/10/13.

Natural England (undated) Standing Advice Species Sheet: Hazel Dormice. http://www.naturalengland.org.uk/Images/Dormice_tcm6-21704.pdf. Accessed on 21/09/13.

Natural England (undated) Standing Advice Species Sheet: Water vole. http://www.naturalengland.org.uk/Images/WaterVoles_tcm6-21714.pdf. Accessed on 21/09/2013

Natural England (undated). Standing Advice Species Sheet; White clawed crayfish. http://www.naturalengland.org.uk/Images/Crayfish_tcm6-21618.pdf Accessed on 21/09/2013

Natural Environment and Rural Communities Act (1996) Chapter 16. Her Majesty's Stationery Office, London.

Peay, S (2002). Guidance on Habitat for White Clawed Crayfish and its restoration. Environment Agency Technical Report W1-067/T

Strachan, R., Moorhouse, T, and Gelling M. (2011). Water Vole Conservation Handbook - Third Edition. Wildlife Conservation Research Unit, Abingdon.

Whitehouse, A.T., Peay, S. & Kindemba, V. (2009). Ark sites for White-clawed Crayfish – Guidance for the aggregates industry. Buglife – The Invertebrate Conservation Trust, Peterborough.

Wildlife and Countryside Act (1981) Chapter 69. Her Majesty's Stationery Office, London.

# HS2 London-West Midlands

# Ecology

# Technical note – Methodology for demonstrating no net loss in biodiversity

## A report to HS2 Ltd by Arup/URS

# Contents

## List of figures



## List of tables



## List of appendix tables

# 1 Introduction

## 1.1 Purpose of this document

1.1.1 The UK Government is committed to halting overall loss in biodiversity by 2020. In line with government policy, High Speed Two Limited (HS2 Ltd) is seeking to ensure that the Phase One London and West Midlands route of the proposed High Speed 2 (HS2) railway (hereafter referred to as the Proposed Scheme) results in no net loss in biodiversity at a route-wide level.

1.1.2 Demonstrating no net loss to biodiversity represents a significant challenge to a large project such as HS2 London-West Midlands (LWM). This document sets out the approach that HS2 Ltd proposes to use to compare biodiversity losses and gains, as a consequence of the Proposed Scheme.

## 1.2 Biodiversity offsetting

1.2.1 Biodiversity offsets are conservation activities designed to deliver biodiversity benefits in compensation for losses, in a measurable way[1]. Offsetting methodologies compare the losses resulting from the impact of a development with the gains achieved through the provision of offsets, thus aiming to provide a transparent mechanism by which the impacts of a development can be quantified, and an appropriate level of compensation agreed.

1.2.2 Biodiversity in its entirety is impossible to measure so offsetting utilises a 'metric' to represent, and provide a measure of, overall biodiversity (Defra 2012b)[2]. Metrics are surrogates[3], or combinations of measurements, that together provide an assessment of the biodiversity value of a particular area (Defra, 2012b). The metric allows the biodiversity impact of a development to be quantified so that the offset requirement, and the value of the compensatory action, can be clearly defined. Metrics are transferable between sites and habitats, allowing an impact on one habitat type to be offset with conservation action elsewhere, or involving a different habitat type and/or quality of habitat (Defra, 2012b).

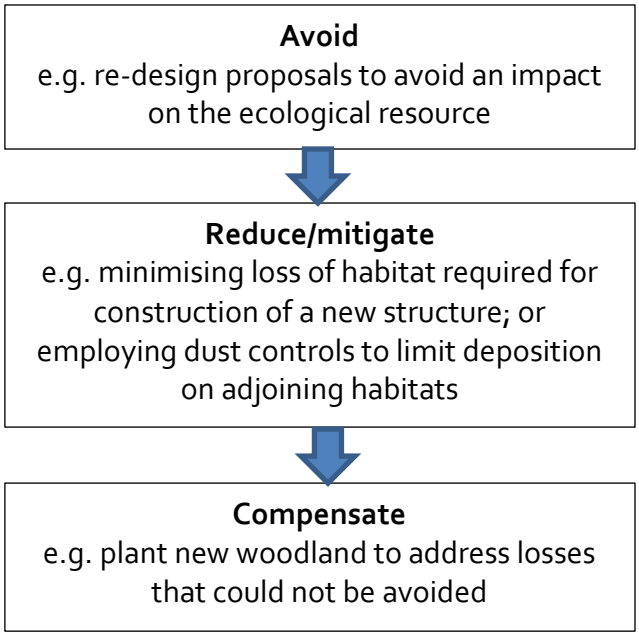
1.2.3 Use and further development of offsetting methodologies is considered vital to ensuring that the planning system secures meaningful compensation which can contribute to the Government's commitment to expand and restore the ecological network in England, and to halt overall biodiversity loss by 2020[4].

## 1.3 Position within the mitigation hierarchy

1.3.1 In seeking to minimise the effects of the Proposed Scheme on biodiversity, the 'mitigation hierarchy' outlined in Figure 1 will be applied.

[1] Defra (2012a), *Biodiversity Offsetting Pilots: Information note for Local Authorities.*
[2] Defra (2012b), *Biodiversity Offsetting Pilots: Technical Paper: the metric for the biodiversity offsetting pilot in England.*
[3] Surrogates are measurements that act as substitute for a complete measurement of the total biodiversity found within a particular area.
[4] Defra (2011), *Biodiversity 2020: A strategy for England's wildlife and ecosystem services.*

Figure 1: Mitigation hierarchy




1.3.2 Offsetting (and the use of offsetting metrics) represents a method of defining an acceptable level of compensatory provision. It occupies a position at the bottom of the mitigation hierarchy, providing the opportunity to quantify compensation, when it has been determined that compensation is required. It does not represent an alternative to the normal application of the mitigation hierarchy. In all cases the earlier stages in the mitigation hierarchy should be considered sequentially before the end point of a requirement for compensation, and thus a need to adopt an offsetting approach is reached.

1.3.3 Where it is accepted that reasonable efforts have been made to explore alternatives during the design process, and the mitigation hierarchy has been applied then the offsetting metric outlined in this document will be utilised to compare the losses and gains in biodiversity that occur as a consequence of the Proposed Scheme.

1.3.4 The approach advocated in the following document should be considered in this context and separated from considerations associated with the avoidance, reduction and mitigation aspects of the hierarchy, which will have been explored in depth independently at earlier stages in the process.

## 1.4 Defra offsetting pilot

1.4.1 The development of a consistent framework for biodiversity offsetting was identified as a priority in the Natural Environment White Paper[5] (2011). In line with this goal, in April 2012 Defra launched a two-year pilot study to trial the use of offsetting in six test areas. The pilot is based upon use of a habitat based 'metric' for considering losses and gains in biodiversity.

1.4.2 The approach involves measuring each area of habitat present before the development against pre-defined scales based on 'distinctiveness' and 'condition'. The scores obtained are then multiplied to give a number of biodiversity units per hectare, and adjusted on the basis of the area of that habitat type present.

[5] HM Government (2011), *The Natural Choice: Securing the value of nature*. HMSO, London.

1.4.3 For example a development will result in the loss of 6 hectares of lowland meadow in moderate condition (further details of the scoring system are provided in Section 3). The number of biodiversity units is calculated as follows :

> Distinctiveness score (6) x habitat condition score (2) x habitat extent (6) = 72 biodiversity units

1.4.4 This step is then repeated for each habitat area within the extent of the development to calculate the number of biodiversity units that will be lost.

1.4.5 The calculation as a whole is then repeated to consider the number of biodiversity units that will be provided by the habitat creation or habitat restoration which has been committed to as part of the proposed development. This calculation considers the extent, distinctiveness and target condition for proposed habitats and a series of multipliers are utilised to ensure the compensation strategy takes into account spatial, temporal and delivery risks associated with the provision of the replacement habitats.

## 1.5 Biodiversity offsetting and HS2 LWM

1.5.1 The Defra offsetting pilot methodology is considered to represent the best available basis for an offsetting methodology that will allow the biodiversity losses and gains of the Proposed Scheme to be robustly assessed. However, a number of amendments to the published pilot methodology are considered necessary to address feedback that has arisen from use of the methodology within the pilot areas, and to ensure that it is suitable for use in support of a landscape scale project.

1.5.2 The key amendments to the Defra pilot methodology which are proposed are:

a. adding an additional 'very high' score under habitat distinctiveness to take account of those habitats of principal importance identified in Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006)[6] which cannot be adequately re-created if lost;

b. Increasing the distinctiveness score attribute to all habitats that form part of an area that qualifies as the habitat of principal importance type open mosaic habitat on previously developed land. Thus ensuring the value of these habitats is fully recognised within the calculation;

c. removing the application of a variable condition weighting for habitats of low distinctiveness - all low distinctiveness habitats will instead automatically attract a condition weighting of 'poor', thus recognising that condition has negligible effect on the overall value of those habitats which are intrinsically of low distinctiveness;

d. incorporating greater consideration of the importance of both habitats lost and gained (in relation to the function of ecological networks) into the spatial risk multipliers, in order to recognise the landscape scale of the project and its impacts; and

e. removing the blanket one-step restriction on the change in condition and replacing this with the condition that for high distinctiveness target habitats a maximum future target condition of moderate can be claimed.

[6] Natural Environment and Rural Communities Act (2006) Chapter 16. Her Majesty's Stationery Office, London.

1.5.3 Details of how these amendments have been incorporated into the metric for the Defra pilot methodology are provided in Sections 2 , 3 and 4 of this report.

1.5.4 HS2 Ltd intends to utilise the methodology contained within this report to calculate and compare the likely biodiversity losses and gains that will occur as a consequence of the Proposed Scheme. In doing so, it will seek to demonstrate in a transparent manner the current position that HS2 LWM has reached in relation to its commitment to seek no net loss of biodiversity at the route-wide level.

1.5.5 The post-development calculation will include consideration of the bespoke areas of ecological compensation to be provided, areas of planting which have been primarily provided to address landscaping considerations, and those habitats that will form part of the operational railway (e.g. cutting slopes). Both spatial risk and delivery risk multipliers will be applied to address the inherent uncertainty involved in habitat creation. These multipliers will serve to temper the number of biodiversity units that can be achieved through the creation of habitats where there is an increased risk of failure.

1.5.6 The focus of ecological compensation for habitat losses to be provided by the Proposed Scheme will be the provision of areas of habitat of principal importance in a manner that will contribute to the 'more, bigger, better' ideals identified in Making Space for Nature (Lawton, 2010)[7].

1.5.7 While an offsetting metric has been used as the means of comparing habitat losses and gains as a consequence of the Proposed Scheme, it is the intention of the project to delivering the new habitats through powers under the hybrid Bill rather than via the establishment of formal offsetting agreements with third parties. The use of formal offsetting agreements with third parties is not envisaged to deliver any of the required measures at this stage, although such agreements may be required to deliver additional measures should these be required.

1.5.8 In all cases where impacts on Sites of Special Scientific Interest (SSSI) occur as a consequence of the Proposed Scheme the requirements for mitigation and compensation have been discussed with Natural England, and will be agreed on a site by site basis (as they would be in the absence of an offsetting approach). This process has followed standard implementation of the mitigation hierarchy.

1.5.9 For completeness, the final compensation package agreed with Natural England for each SSSI will be scored on the basis of the metric outlined in this document and will be included as part of the calculations to be undertaken to consider the balance of losses and gains at the route-wide level.

1.5.10 As the offsetting metric is not being used to drive the level of compensation provided for impacts on SSSI, the inclusion of habitats falling within SSSI within the offsetting calculation is not considered to condone impacts on SSSI, nor act to contradict current planning guidance or Natural England processes for dealing with these impacts.

[7] Lawton J (Chair) (2010), *Making Space for Nature: A review of England's Wildlife Sites and Ecological Network.* Report to Defra.

# 2 Units within the metric

## 2.1 Habitat parcels

2.1.1 The metric to be utilised for HS2 LWM represents a modified version of the Defra pilot methodology, and will predominantly utilise habitat parcels as the basis for comparing losses and gains in biodiversity as a consequence of the Proposed Scheme.

2.1.2 Phase 1 habitat survey and National Vegetation Classification (NVC) data (where available) will be utilised to identify all habitats parcels that meet one of the following criteria:

- habitats located within the extent of the land required for the construction of the Proposed Scheme[8];
- habitats located within the extent of any areas proposed for habitat creation or habitat enhancement (where these lie outside the boundaries of the land required for the construction of the Proposed Scheme); and
- areas of habitat outside the land required for the construction of the Proposed Scheme where the Environmental Statement (ES) identifies that the habitat is likely to be subject to adverse effects considered to be significant at the district/borough level or above[9] as a consequence of the Proposed Scheme.

2.1.3 Each habitat parcel which meets one of the criteria identified in paragraph 2.1.3 will be allocated a weighted score on the basis of each of the following criteria:

- habitat distinctiveness;
- habitat condition; and
- position within ecological network.

2.1.4 The modified metric will be used to calculate the number of biodiversity units afforded to the habitat parcels that will be affected by the Proposed Scheme. This total will subsequently be compared with the number of biodiversity units that are achieved by habitat parcels present post-development.

### Arable field margins

2.1.5 Arable field margins specifically managed for wildlife and likely to qualify as the habitat of principal importance type arable field margins are infrequent across the route of the Proposed Scheme. Where field survey or interpretation of aerial photographs identifies the presence of margins that may qualify, then a standard width of 10m will be used to provide an estimate of the number of biodiversity units that are contributed by such features.

2.1.6 For all other arable fields falling within the scope of the pre-development calculations it will be assumed that an uncultivated arable margin of 1m width and moderate distinctiveness is present. Such features are too small to map accurately but given the

[8] The land required for the construction of the Proposed Scheme is defined as the combined extent of all areas of land required either temporarily during construction or permanently during operation.
[9] The significance of effects described in the ecological impact assessment of the Proposed Scheme follows the methodology set out in: Institute of Ecology and Environmental Management, (2006), *Guidelines for Ecological Impact Assessment in the United Kingdom*. IEEM, Winchester.

scale of the Proposed Scheme could contribute a significant number of biodiversity units at the route-wide level.

2.1.7 The biodiversity units generated by arable field margins will be considered as part of the overall biodiversity units score generated by habitat parcels.

## 2.2 Linear features – hedgerows and watercourses

2.2.1 Hedgerows and watercourses will be considered as linear features and each will form a separate aspect of the offsetting calculation.

2.2.2 Both hedgerows and watercourses will generate their own number of biodiversity units pre- and post-development. Due to the unique nature of both habitat types it will only be suitable to offset losses on these habitat types through the provision of the same habitat type (i.e. loss of hedgerow can only be offset by creation of more hedgerows).

2.2.3 Losses and gains will generate biodiversity units based on the length of hedgerow or watercourse lost or gained. Other multipliers will be utilised where applicable, and in order to ensure clarity, consideration of hedgerows and watercourses as part of the calculation is covered separately in this document.

# 3 Calculating pre-development biodiversity units

## 3.1 Habitat distinctiveness

3.1.1 Habitat distinctiveness will be scored against a five category scale as detailed in Table 1.

3.1.2 Under the Defra pilot methodology all areas of habitat of principal importance fall within a 'high' category which scores a weighting of 6. Under the HS2 LWM methodology this category has been sub-divided to create a new 'very high' distinctiveness category, which will score a weighting of 8.

3.1.3 The 'very high' category will be utilised for all examples of habitat of principal importance present prior to development that cannot be adequately re-created if lost. For the Proposed Scheme this category will cover semi-natural ancient woodland, mature heathland and lowland fen.

3.1.4 The 'very high' category will not be used in the post-development calculation (see Section 4.2) (i.e. the maximum target distinctiveness weighting available post-development will be 6) in order to acknowledge that such habitat types (including ancient semi-natural woodland) are irreplaceable and losses cannot be addressed within the timeframes of the offsetting calculation. The undertaker will continue to adopt best practice measures to translocate the soils and seed/bud bank from such habitats, in order to give the best possible chance of providing similar habitat in the long term.

3.1.5 This approach in relation to irreplaceable habitats is considered acceptable taking into account the position that offsetting occupies within the mitigation hierarchy (i.e. after due consideration of avoidance, reduction and mitigation measures).

Table 1: Habitat type bands

| Distinctiveness | Habitats types included | Weighting |
|---|---|---|
| Very high | Habitats of principal importance (Tier 1)<br>This category consists of habitats meeting habitat of principal importance definition and which cannot be adequately re-created if lost.<br>Habitats occurring within the HS2 LWM route which fall into this category are as follows[10]:<br>Ancient semi-natural woodland;<br>Mature lowland heathland;<br>Lowland fen.<br>N.B. Plantation on ancient woodland should be considered to fall under the 'high' distinctiveness category. | 8 |

[10] Mature heathland and lowland fen are included here as a precaution due to their known occurrence within proximity to the land required for the construction of the Proposed Scheme.

| Distinctiveness | Habitats types included | Weighting |
|---|---|---|
| High | Habitats of principal importance (Tier 2) i.e. those which meet the criteria[11] to qualify as habitats of principal importance but do not qualify under the definition for 'very high' category above. | 6 |
| Moderate | Other semi-natural habitats that do not fall within the scope of habitats of principal importance definitions, i.e. all other areas of woodland (e.g. non-native coniferous plantation), other grassland (e.g. species poor semi-improved), uncultivated field margins, road verge and railway embankments (excluding those that are intensively managed). | 4 |
| Low | Improved grassland, arable fields (excluding any uncultivated margins), built up areas, domestic gardens, regularly disturbed bare ground (e.g. quarry floor, landfill sites etc.), verges associated with transport corridors. | 2 |
| None | Transport corridors (without associated verges), landfill sites, spoil heaps. | 0 |

3.1.6 Phase 1 habitat survey and National Vegetation Classification (NVC) (where available) data will be utilised as the basis for allocating a distinctiveness score to all habitats parcels that meet the criteria outlined in paragraph 2.1.2.

3.1.7 Where Phase 1 habitat data collected during field surveys in support of the Proposed Scheme are available, this data will be utilised. Where no field survey information is available, gaps should be filled utilising either Phase 1 habitat data derived from aerial photography analysis or through use of Phase 1 habitat data derived from habitat inventories (where available).

3.1.8 The categories utilised within the metric for the Defra pilot are principally aligned with the use of the Integrated Habitat System (IHS) (an alternative habitat classification methodology) which splits out habitats of principal importance from those that do not qualify under these criteria. Appendix A provides guidance to be utilised in translating Phase 1 habitat data into the habitat distinctiveness categories identified in Table 1. It aims to ensure each habitat type is broadly aligned with the guidance provided in Appendix 1 to the Defra guidance for offset providers and developers.[12]

3.1.9 As Phase 1 habitat categories and habitats of principal importance definitions do not always strongly correlate, in some cases a single Phase 1 habitat type could include both areas that qualify as habitats of principal importance and other areas that do not. As a consequence in allocating distinctiveness ratings it will be necessary to subdivide some Phase 1 habitat polygons for the purposes of the offsetting calculation.

3.1.10 Phase 1 habitat categories which are recorded as point data (e.g. scattered scrub or individual trees) will be considered on the basis of the distinctiveness rating of the underlying habitat polygon. Where the presence of a point data category is considered to add to the distinctiveness rating of the underlying habitat type (e.g. the presence of the scattered scrub within an area of ephemeral/short perennials) then the distinctiveness rating of the underlying habitat type polygon will be adjusted manually to account for this.

3.1.11 For those Phase 1 habitat types where more than one potential weighting score has been identified it will be necessary for an ecologist to review available habitat data

[11] UK BAP (2011), UK Biodiversity Action Plan – Priority Habitat Descriptions. http://jncc.defra.gov.uk/PDF/UKBAP_PriorityHabitatDesc-Rev2011.pdf Accessed 17 August 2013.
[12] Defra (2012), Appendix 1 - Distinctiveness Bands for the Biodiversity Offsetting Pilot. http://archive.defra.gov.uk/environment/biodiversity/offsetting/documents/1204-bio-offset-pilot-appendix.pdf Accessed: 09 Feb 2013.

(including information from any subsequent Phase 2 surveys conducted) and allocate a score, based on the guidance provided in Table 1.

3.1.12 When scoring habitat polygons, consideration will be given to those locations where the combination of habitats present may fall within the definition of the habitat of principal importance 'open mosaic habitat on previously developed ground'.

3.1.13 Where a combination of habitat polygons are considered to collectively meet the criteria for the open mosaic on previously developed ground (habitat of principal importance type) then all habitat parcels which fall under the scope of the definition should be upgraded to a distinctiveness rating of high (6 points) (e.g. areas of tall ruderals and short ephemerals which may alone have scored 2 for distinctiveness would each be upgraded to scoring 6, while the areas of interconnecting bare ground would continue to score a 2).

3.1.14 The habitat definition for open mosaic habitat on previously developed ground sets a minimum threshold for this habitat type of 0.25ha. The minimum size refers to the potential open mosaic habitat which could be part of a larger site, containing other elements such as woodland or developed land.

3.1.15 Continuous blocks of a closed plant community greater than 0.25 ha should as a general rule be classified according to the relevant habitat category, although those containing very fine-grained mosaics might qualify under the open mosaic on previously developed ground definition.

## 3.2 Habitat condition

3.2.1 All habitat parcels classified as falling within distinctiveness bands very high, high and moderate will be rated against a three-point condition scale with reference to the Higher Level Stewardship (HLS) agri-environment scheme condition assessment tool (Natural England, 2010)[13] utilised within the pilot methodology.

3.2.2 The condition scale is basic and where it is applicable, habitat survey notes will be utilised to allocate a condition score to each habitat parcel (see Table 2 below). Where all of the stated criteria are met then a condition assessment category of good (or A rating) is given. Where one of the criteria is missed or failed then a moderate (B rating) is given, and where two or more criteria are failed/missed then a low condition (C rating) is allocated.

Table 2 Condition weighting scale

| Condition score | HLS condition assessment category | Framework for those habitats which are not covered by HLS condition assessment |
|---|---|---|
| 3 | A rating | Good |
| 2 | B rating | Moderate |
| 1<br><br>N.B A condition score of 1 will also be automatically applied to all habitats of low distinctiveness | C rating | Poor |

[13] Natural England (2010), *Higher Level Stewardship – Farm Environment Plan (FEP) Manual – Technical guidance on the completion of the FEP and identification, condition assessment and recording of HLS FEP features.* Natural England.

3.2.3 The HLS guidance does not cover all habitat types that fall within the scope of this assessment, and where the HLS assessment guidance (Natural England, 2010) provides no relevant criteria then professional judgement will be applied to allocate a condition score against the three-point scale. Ecologists undertaking the condition scoring will be encouraged to discuss those situations where it is necessary to apply professional judgement, and a decision log will be maintained in order to ensure such judgements are consistently applied across the route.

3.2.4 All habitats identified as being of low habitat distinctiveness will automatically be allocated a condition weighting of 1. This modification to the metric reflects the view that for habitats of low distinctiveness the condition of the habitat has negligible influence on the overall value of that habitat type. For similar reasons no condition rating will be applied to assumed arable field margins.

3.2.5 Where access has not been obtained for survey then it will be necessary to allocate a condition score based on a precautionary approach informed by professional judgement. A condition score of 3 (good) is likely to be achieved only by those habitats which are being actively managed to maximise their value for nature conservation. As a consequence, where existing data suggest that land is likely to be subject to management aimed to maximise its nature conservation value, then a score of 3 will be allocated.

3.2.6 As a general rule, in the absence of access to conduct survey a moderate condition (2 points) will be assumed. A condition score of poor (1 point) should be allocated where there is a very clear justification for this conclusion based on the information available.

## 3.3 Position within existing ecological network

3.3.1 A key consideration of current nature conservation policy and guidance is the goal of working towards the creation of 'bigger, better and more joined up'[14] ecological networks.

3.3.2 While the offsetting pilot methodology considers spatial risks associated with the location of compensation provision, it does not implicitly consider the importance of the habitats lost to existing ecological networks. Based on the landscape scale of the Proposed Scheme a multiplier will be utilised in both the pre- and post-development calculations to take account of the importance of habitats lost to existing ecological networks.

3.3.3 Incorporating consideration of the spatial distribution of habitats both before and after development, and their potential role in the function of ecological networks is considered to represent a more accurate method of quantifying how the project as a whole will affect progress towards the Lawton Review goals of 'bigger, better and more joined up' (Lawton, 2010).

3.3.4 Therefore for each habitat parcel a score will be allocated based on the importance of the habitat lost for the surrounding ecological network, according to the criteria shown in Table 3 .

3.3.5 The criteria utilised seek to acknowledge the inherent value of larger and well-connected habitat blocks, particularly those that support habitats of principal

[14] Lawton J (2010), *Making Space for Nature: A review of England's Wildlife Site's and Ecological Network*.

importance. The criteria are intended as a means of ensuring these broad concepts are taken into account in the offsetting calculation. They should not be interpreted as an attempt to consider species-specific requirements within the calculation.

3.3.6 It is envisaged that Geographical Information Systems (GIS) software will be used to write queries to assist in the process of calculating scores relating to the position in the ecological network.

Table 3: Consideration of position within ecological network prior to development

| Importance within existing ecological network | Multiplier |
|---|---|
| • Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is of more than 1ha in size[15] (core habitat block') and have connectivity with other areas of semi-natural habitat[16] | 3 |
| • Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is of more than 1ha in size but have little or no connectivity with other areas of semi-natural habitat (i.e. those that do not fall under score of 3 above);<br>• Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is of between 0.25ha and 1ha in size (regardless of connectivity – these are considered as 'stepping stones');<br>• Habitat which forms part of an area of semi-natural habitat[17] which provides continuous physical connectivity between existing 'core habitat blocks'[18]. | 2 |
| • Any other areas which do not meet the criteria identified for either a multiplier of 2 or 3 above. | 1 |

## 3.4 Hedgerows

3.4.1 For hedgerows, as the vast majority of all hedgerows will meet the definition for this habitat of principal importance type, the distinctiveness criteria will not be utilised within the calculation.

3.4.2 Gaps of greater than 15m will be considered to represent a break in the hedgerow. Where double hedgerows occur then the length of each constituent hedgerow will be fed into the metric.

3.4.3 As in the Defra pilot method the condition of each hedgerow (or hedgerow section) will be scored against a three-point condition scale (see Table 4), with reference to the guidance provided in the Higher Level Stewardship Farm Environmental Plan handbook (Natural England, 2010).

Table 4: Multiplier to be applied for condition of hedgerows and watercourses

| Condition of feature lost | Multiplier applied |
|---|---|
| Good | 3 |
| Moderate | 2 |
| Poor | 1 |

3.4.4 Where field survey was undertaken then notes from hedgerow surveys will be utilised to inform the scoring for habitat condition. Where no access was available for survey

[15] For the purposes of the calculation where areas of habitat of principal importance are separated by gaps of non-qualifying habitat of 15m or less then these should be considered to be contiguous (unless professional judgement of an ecologist considers otherwise).
[16] Based on professional judgement those core areas which have little or no connectivity with other areas of semi-natural habitat should be downgraded to a multiplier of 2 where it is considered that their lack of connectivity is likely to limit their value within the existing ecological network (e.g. for example a severed area of woodland surrounded by an arable field would be downgraded to a multiplier of 2).
[17] Defined for the purposes of this calculation as any area allocated a very high, high or moderate distinctiveness score.
[18] Physical connectivity is defined for this purpose as a 'continuous' corridor of moderate, high or very high distinctiveness habitat parcels. As a general rule a gap in qualifying habitat of more than 15m in extent, or a section where the minimum width of connective habitat drops below 5m in width (note hedgerows are considered as part of a separate calculation) should be considered to represent a break in connectivity.

then this will be informed solely by information obtained from aerial photographs and a precautionary approach will be adopted.

3.4.5 In addition to the condition score for hedgerows, a multiplier will be attributed (see Table 5) for the position in the ecological network in order to ensure that the value of the features lost within existing ecological networks are considered fully within the offsetting calculation.

Table 5: Position of hedgerow within existing network

| Position within existing network | Multiplier applied |
|---|---|
| Hedgerows which under the Hedgerows Regulations (1997[19]) scoring achieves a connection score of 4 points or more [20] | 3 |
| Hedgerow achieving a connection score of 3 or 2 | 2 |
| Hedgerow achieving a connection score of 1 point or less | 1 |

## 3.5 Watercourses

3.5.1 For watercourses, it is assumed that all watercourses will be considered as being of high distinctiveness. As a consequence, distinctiveness multipliers are not to be used in the calculation.

3.5.2 For watercourses the use of the position in the network multiplier is also not considered worthwhile given that all watercourses will provide linear connectivity along their route, and that compensation will likely be provided through the realignment of the same channel. As such, position in the landscape is unlikely to change.

3.5.3 As a consequence the number of biodiversity units generated by the watercourses currently present would be calculated by multiplying the length (m) by a condition score using the scale shown in Table 5. This should utilise the criteria set out in the Higher Level Stewardship Farm Environmental Plan handbook (Natural England, 2010), alongside professional judgement where necessary.

## 3.6 Deriving the total biodiversity units present pre-development

### Habitat parcels/polygons

3.6.1 Following the scoring of all habitat parcels for habitat distinctiveness, condition and position within existing ecological networks, the total number of pre-construction biodiversity units will be calculated for each parcel/polygon (including those assumed for arable field margins) using the following formula:

> Number of biodiversity units generated by habitat polygon = Habitat distinctiveness rating x habitat condition x habitat area x position within existing ecological network.

3.6.2 The scores generated by each individual habitat parcel will then be summed to provide the total number of biodiversity units generated by the habitat parcels present pre-development.

[19] The Hedgerows Regulations (1997) (SI 199 No. 1160). Her Majesty's Stationery Office. London.

[20] Under the criteria used to define connections within The Hedgerows Regulations (1997) a connection with another hedgerow scores one point and a connection with a pond or a woodland in which the majority of trees are broadleaved trees scores 2 points; and a hedgerow is connected with something not only if it meets it but also if it has a point within 10 metres of it and would meet it if the line of the hedgerow continued.

## Linear features

3.6.3 The number of biodiversity units present pre-development should be calculated for both hedgerows and watercourses.

3.6.4 The number of hedgerow units present prior to construction of the Proposed Scheme would be calculated as follows

> Number of biodiversity units generated by individual hedgerow feature = length of hedgerow (m) x condition multiplier attributed x position in the network.

3.6.5 For watercourses the number of units present pre-development should be calculated as follows:

> Number of biodiversity units generated by individual watercourse = length (m) x condition multiplier attributed

3.6.6 Separate totals will then be calculated for biodiversity units generated by a) hedgerows and b) watercourses present prior to development.

# 4 Calculating post-development biodiversity units

## 4.1 General

4.1.1 The post-development side of the no net loss calculation will be based upon the final design, and will incorporate consideration of the habitats that are to be created as part of the Proposed Scheme. This will include both those habitat areas to be created with the primary purpose of providing ecological compensation, and those where the primary purpose is non-ecological (e.g. planting to address landscape effects).

## 4.2 Habitat distinctiveness

4.2.1 For all habitat parcels to be created as part of the Proposed Scheme a target distinctiveness score will be allocated according to the 'high', 'moderate', 'low' or 'none' categories provided in Table 1.

4.2.2 Where the Proposed Scheme results in the loss of habitats that fall within the 'very high' distinctiveness band then it is acknowledged that such habitats cannot be adequately re-created within the timeframe of the project. As a consequence while habitat creation, restoration and on-going management will still seek to achieve areas of similar distinctiveness in the long term (e.g. through the translocation of ancient woodland soils), for the purposes of the post-development calculations it will not be possible to allocate distinctiveness score of very high.

4.2.3 In line with the principles set out in the Defra pilot methodology, the offsetting approach will seek to improve the extent or condition of the ecological network. Unavoidable losses of habitats within the very high distinctiveness category (e.g. ancient semi-natural woodland) will therefore be addressed through the provision of larger areas of 'high' distinctiveness habitat as compensation.

4.2.4 If the habitat impacted by the Proposed Scheme is in the high distinctiveness band, the offset will usually be 'like for like' i.e. it will aim to create or restore the same type of habitat.

4.2.5 For habitat of medium distinctiveness, the offset will largely be made up of habitat from the same distinctiveness band or higher (i.e. habitat from the medium or high distinctiveness band). Where the habitat lost was low distinctiveness, the offset should involve a 'trade up' in distinctiveness (i.e. be largely made up of habitat from the medium or high distinctiveness band).

## 4.3 Target condition

4.3.1 The offsetting approach for the Proposed Scheme will not utilise the two-step constraint that has been implemented within the Defra offsetting pilot. Instead a cap will be placed on the target condition that can be predicted for the creation of high distinctiveness habitats, with a maximum of a moderate target condition utilised for any such habitats. This approach seeks to recognise the fact that there can be limited confidence in achieving high distinctiveness habitats.

4.3.2 Where habitat restoration or enhancement is proposed then a habitat condition of high can be targeted for habitats of high, moderate or low distinctiveness.

4.3.3 All predictions of target condition should assume that suitable management will be available as a minimum for the period required to ensure target condition is achieved. It should thus be assumed that all habitats that are to be created for the primary purpose of ecological mitigation will aim to achieve the maximum target condition available (i.e. a score of 3 for habitats of moderate distinctiveness and 2 for habitats of high distinctiveness). Given the provision of appropriate management these are considered realistic targets.

## 4.4 Position within the surrounding ecological network

4.4.1 Where new habitats are created or restoration works are undertaken, position within the surrounding ecological network, as defined in Table 6, will be utilised to promote compensation provision that will contribute to the Lawton Review principles of 'bigger, better and more joined up' (Lawton, 2010). The criteria used mirror those used in the pre-development side of the calculation, with the addition that a score of 3 will be gained for areas of compensation that fall within the aims of a specified Nature Improvement Area (NIA) or Biodiversity Opportunity Area (BOA) scheme.

4.4.2 Each element of compensation or enhancement provision that is provided as part of the Proposed Scheme should be allocated a score (on a scale of 1-3) to identify the role that the habitat area will play in the ecological network that is present post-development.

Table 6: Consideration of position within ecological network post-development

| Importance within ecological network | Multiplier |
|---|---|
| • Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is more than 1ha in size [21] (this may be as a result of either creation of new areas of habitat or the expansion of existing habitat areas) and have connectivity with other areas of semi-natural habitat [22];<br>• Areas of habitat creation or expansion within the aims of a specified Nature Improvement Area (NIA) or Biodiversity Opportunity Area (BOA) scheme. | 3 |
| • Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is of more than 1ha in size but have little or no connectivity with other areas of semi-natural habitat (i.e. those that do not fall under score of 3 above);<br>• Habitat areas which form part of a contiguous area of habitat(s) of principal importance which is between 0.25ha and 1ha in size (regardless of connectivity – these are considered as 'stepping stones');<br>• Habitat which forms part of an area of semi-natural habitat [23] which provides continuous physical connectivity between existing 'core habitat blocks'. [24] | 2 |
| • any other areas which do not meet the criteria identified for either a multiplier of 2 or 3 above. | 1 |

## 4.5 Hedgerows

4.5.1 The post-development number of biodiversity units generated by hedgerows should be calculated based on the following criteria:

- length of hedgerow to be created (m);

[21] For the purposes of the calculation where areas of habitat of principal importance are separated by gaps of non-qualifying habitat of 15m or less then these should be considered to be contiguous (unless professional judgement of an ecologist considers otherwise).
[22] Based on professional judgement those core areas which have little or no connectivity with other areas of semi-natural habitat should be downgraded to a multiplier of 2 where it is considered that their lack of connectivity is likely to limit their value within the existing ecological network (e.g. for example a severed area of woodland surrounded by an arable field would be downgraded to a multiplier of 2).
[23] Defined for the purposes of this calculation as any area allocated a very high, high or moderate distinctiveness score.
[24] Physical connectivity is defined for this purpose as a 'continuous' corridor of moderate, high or very high distinctiveness habitat parcels. A gap in qualifying habitat of more than 15m in extent, or a section where the minimum width of connective habitat drops below 5m in width (note hedgerows are considered as part of a separate calculation) should as a general rule be considered to represent a break in connectivity.

- target condition – based on the three-point scale provided in Table 4; and
- position of the hedgerow within the post-development network – based on the same criteria used in Table 5.

## 4.6 Watercourses

4.6.1 For watercourses the post-development number of biodiversity units generated should be calculated through multiplying the length (m) by the multiplier for target condition shown in Table 4.

## 4.7 Difficulty of re-creating/restoring

4.7.1 The multipliers proposed in the Defra pilot methodology will be utilised to recognise delivery risk. Habitats will be assigned to the following broad categories of re-creation/restoration risk based on professional judgement, input of Natural England specialists and previous research work. Full details are presented in the Technical Paper which accompanies the offsetting pilot methodology (Defra, 2012).

Table 7: Consideration of difficulty of re-creating/restoring

| Difficulty of re-creation/restoration | Multiplier |
|---|---|
| Very High | 0.10 |
| High | 0.33 |
| Medium | 0.75 |
| Low | 1.00 |

## 4.8 Time to target condition

4.8.1 In delivering offsets there may be a mismatch in the timing of impact and offset. This is defined in the offsetting pilot methodology as the difference in time between the negative impact on biodiversity and the offset reaching the required quality or level of maturity. This mismatch results in loss of biodiversity for a period of time.

4.8.2 It is intended that the time discounting rate of 3.5% proposed in the pilot methodology and detailed in Table 8 below is utilised unchanged for the Proposed Scheme. This is based on the discounting rate recommended in the Treasury's Green Book[25]. For practical purposes a cap on the multiplier has been placed at 0.33.

Table 8: Consideration of time to target condition

| Years to target condition | Multiplier |
|---|---|
| 5 | 0.83 |
| 10 | 0.71 |
| 15 | 0.58 |
| 20 | 0.50 |
| 25 | 0.41 |
| 30 | 0.36 |
| 32 or above | 0.33 |

[25] HM Treasury (2011) *The Green Book: Appraisal and Evaluation in Central Government*, Her Majesty's Stationery Office, London.

4.8.3 Table 9 provides the main habitat types and associated time to target condition categories that will be applied in the calculation. For hedgerows and grassland the most appropriate category should be selected based on the type of hedgerow/grassland that has been targeted.

Table 9: Time to target condition multipliers for main compensation habitats proposed

| Habitat type | Years to target condition category |
|---|---|
| Open mosaic habitats on previously undeveloped ground | 5 |
| Ponds | 5 |
| Grasslands | 5 or10 |
| Hedgerows | 5 or 10 |
| Woodland (for landscaping) | 10 |
| Young heathland/acid grassland | 15 |
| Mature heathland | 32 or above |
| Woodland (for ecological purposes) | 32 or above |

## 4.9 Deriving the total number of biodiversity units present post-development

### Habitat parcels/polygons

4.9.1 The scores of each polygon/habitat parcel present post-development will be calculated utilising the following criteria:

> Number of biodiversity units generated by habitat polygon post-development = target habitat distinctiveness rating x target habitat condition x habitat area x position within existing ecological network x difficultly of re-creating/restoring x time to target condition

4.9.2 The scores of each polygon will then be added to give the total number of biodiversity units provided by the habitats present post-construction.

### Linear features

4.9.3 The number of biodiversity units present post-development should be calculated for both hedgerows and watercourses as follows:

> Number of biodiversity units generated by individual hedgerow feature = length of hedgerow (m) x condition multiplier attributed x position in the network x difficulty of re-creating/restoring x time to target condition
>
> Number of biodiversity units generated by individual watercourse = length (m) x condition

4.9.4 The figures for the biodiversity units present post-development will then be compared with the overall pre-development score for the scheme to establish the overall balance of biodiversity units (negative or positive).

## 4.10 Deriving the change in biodiversity units as a consequence of the Proposed Scheme

4.10.1 In order to establish the change in biodiversity units as a consequence of the Proposed Scheme the number of biodiversity units generated post-development will be subtracted from the number available pre-development:

> Net change in biodiversity units = post-development total units – pre-development total units for the same area

4.10.2 This calculation will be conducted at the route wide level for each of the following separate elements of the calculation:

- habitat parcels (including arable field margins);
- hedgerows; and
- watercourses.

# 5 Undertaking the calculation

5.1.1 The principles of the metric described in this document have been utilised to guide the size, location and type of compensatory habitat provision that has been incorporated into the design of the Proposed Scheme. Trial calculations have also been undertaken in order to test use of the revised metric throughout the development of the metric.

5.1.2 HS2 Ltd is committed to utilising the metric to provide a calculation showing what the project has achieved in working towards the goal of seeking no net loss in biodiversity.

5.1.3 It may be appropriate to repeat the calculation both as the hybrid Bill progresses through Parliament, and as result of detailed design. The metric therefore has the potential to provide an iterative mechanism to review changes in the balance of ecological loss versus compensation associated with the Proposed Scheme.

# 6 References


Defra (2011), Biodiversity 2020: *A strategy for England's wildlife and ecosystem services*. Defra.

Defra (2012*), Biodiversity Offsetting Pilots: Information note for Local Authorities*. Defra.

Defra (2012), *Biodiversity Offsetting Pilots: Technical Paper: the metric for the biodiversity offsetting pilot in England*. Defra.

Defra (2012), *Appendix 1 - Distinctiveness Bands for the Biodiversity Offsetting Pilot*. http://archive.defra.gov.uk/environment/biodiversity/offsetting/documents/1204-bio-offset-pilot-appendix.pdf Accessed: 09 Feb 2013.

HM Government (2011), *The Natural Choice: Securing the value of nature*. HMSO, London.

HM Treasury (2011), *The Green Book: Appraisal and Evaluation in Central Government*. Her Majesty's Stationery Office, London.

Lawton J (Chair) (2010), *Making Space for Nature: A review of England's Wildlife Sites and Ecological Network*. Report to Defra.

Natural England (2010), *Higher Level Stewardship – Farm Environment Plan (FEP) Manual – Technical guidance on the completion of the FEP and identification, condition assessment and recording of HLS FEP features*. Natural England.

Natural Environment and Rural Communities Act (2006) Chapter 16. Her Majesty's Stationery Office, London.

The Hedgerows Regulations (1997) (SI 199 No. 1160). Her Majesty's Stationery Office. London.

UK BAP (2011) UK Biodiversity Action Plan – Priority Habitat Descriptions. http://jncc.defra.gov.uk/PDF/UKBAP_PriorityHabitatDesc-Rev2011.pdf Accessed 17 August 2013

# Appendix A: Habitat distinctiveness scores for Phase 1 habitat survey categories

Table A 1: Habitat distinctiveness scores for Phase 1 Habitat categories

| Phase 1 code | Habitat description | Distinctiveness | Weighting | Guidance |
|---|---|---|---|---|
| A1.1.1 | Broadleaved woodland - semi-natural | Very high/high | 8/6 | Very high rating to be applied to all areas qualifying as ancient semi-natural woodland. All other areas to be identified as high distinctiveness. |
| A1.1.2 | Broadleaved woodland - plantation | Moderate | 4 | - |
| A1.2.1 | Coniferous woodland - semi-natural | High | 6 | - |
| A1.2.2 | Coniferous woodland - plantation | Moderate | 4 | - |
| A1.3.1 | Mixed woodland - semi-natural | Very high/high/ moderate | 8/6/4 | Consider potential to split out areas of woodland that qualify as a habitat of principal importance, or as ancient semi-natural woodland (very high) and validity of including as part of the underlying habitat of principal importance where the coniferous cover is less than 25%. Such areas could score a high distinctiveness rating.<br>All others will score a moderate rating. |
| A1.3.2 | Mixed woodland - plantation | High/moderate | 6/4 | High distinctiveness rating to be allocated to those sites which meet the criteria to qualify under habitat of principal importance type 'traditional orchard'. Moderate rating to be applied for all others. |
| A2.1 | Scrub - dense/ continuous | Moderate | 4 | - |
| A2.2 | Scrub - scattered | Low | 2 | This habitat type could have been created as either a polygon or point data. Only polygon data should be utilised within the assessment. |
| A3.1 | Broadleaved parkland/ scattered trees | High/moderate | 6/4 | This habitat type only to be utilised where mapped as a polygon. High distinctiveness rating to be applied to habitats falling under the wood pasture and parkland habitat of principal importance type. Moderate rating to be applied in all other cases. |
| A3.2 | Coniferous parkland/ scattered trees | Moderate | 4 | This habitat type only to be utilised where mapped as a polygon. |
| A3.3 | Mixedparkland/ scattered trees | Moderate | 4 | This habitat type only to be utilised where mapped as a polygon. |
| A4.1 | Broadleaved woodland - recently felled | Moderate | 4 | |
| A4.2 | Coniferous woodland - recently felled | Moderate | 4 | |
| A4.3 | Mixed woodland - recently felled | Moderate | 4 | |
| B1.1 | Acid grassland - unimproved | High | 6 | |
| B1.2 | Acid grassland - semi-improved | High | 6 | |
| B2.1 | Neutral grassland - | High | 6 | |

| Phase 1 code | Habitat description | Distinctiveness | Weighting | Guidance |
|---|---|---|---|---|
| | unimproved | | | |
| B2.2 | Neutral grassland - semi-improved | High/moderate | 6/4 | Split out those areas of grassland that fall within the lowland meadows habitat of principal importance type, and identify these as being of high distinctiveness. Moderate rating to be applied in all other cases. |
| B3.1 | Calcareous grassland - unimproved | High | 6 | |
| B3.2 | Calcareous grassland - semi-improved | High/moderate | 6/4 | Split out those areas falling under the definition of lowland calcareous grassland habitat of principal importance type. All other areas of grassland which contain elements of a calcareous sward should be considered to be of moderate distinctiveness. |
| B4 | Improved grassland | Low | 2 | |
| B5 | Marsh/marshy grassland | High/moderate | 6/4 | Split out any areas that represent habitats of principal importance (in particular purple moor grass and rush pasture) and identify these as of high distinctiveness. All others should be considered to be of moderate distinctiveness. |
| B6 | Poor semi-improved grassland | Moderate | 4 | |
| C1.1 | Bracken - continuous | Low | 2 | |
| C1.2 | Bracken - scattered | Low | 2 | Only those areas mapped as polygons should be used within the calculation. |
| C3.1 | Other tall herb and fern - ruderal | Low | 2 | |
| C3.2 | Other tall herb and fern - non ruderal | Low | 2 | |
| D1.1 | Dry dwarf shrub heath - acid | High | 6 | |
| D1.2 | Dry dwarf shrub heath - basic | High | 6 | |
| D2 | Wet dwarf shrub heath | High | 6 | |
| D5 | Dry heath/acid grassland | Very high/high | 8/6 | Only mature and diverse areas of heath should be taken as qualifying in the very high category. All other areas to be classified as high. |
| D6 | Wet heath/acid grassland | Very high/high | 8/6 | Only mature and diverse areas of heath should be taken as qualifying in the very high category. All other areas to be classified as high. |
| E2.1 | Flush and spring - acid/neutral flush | High | 6 | |
| E2.2 | Flush and spring - basic flush | High | 6 | |
| F1 | Swamp | High/moderate | 6/4 | Identify those areas that qualify under the reedbed or purple moor grass and rush pasture habitat of principal importance definitions as being in the high category. Identify all others areas as being of moderate distinctiveness. |
| F2.1 | Marginal and | High/moderate | 6/4 | This Phase 1 category is defined as strips of |

| Phase 1 code | Habitat description | Distinctiveness | Weighting | Guidance |
|---|---|---|---|---|
| | inundation - marginal vegetation | | | emergent vegetation that are of less than 5m in width. Identify those areas that qualify under purple moor grass and rush pasture habitat of principal importance definitions as being of high distinctiveness. |
| F2.2 | Marginal and inundation - inundation vegetation | High/moderate | 6/4 | Consider potential for this habitat to fall under any habitat of principal importance definition (considered unlikely). All other to be identified as moderate. |
| G1 | Standing water | High/moderate | 6/4 | Habitats of principal importance should be identified as being of high distinctiveness.<br>All other occurrences of this habitat type should be identified as being of moderate distinctiveness. |
| G1.1 | Standing water - eutrophic | High/moderate | 6/4 | |
| G1.2 | Standing water - mesotrophic | High/moderate | 6/4 | |
| G1.3 | Standing water - oligotrophic | High/moderate | 6/4 | |
| G1.4 | Standing water - dystrophic | High/moderate | 6/4 | |
| G1.5 | Standing water - marl | High/moderate | 6/4 | |
| I1.1.1 | Inland cliff - acid/neutral | High | 6 | |
| I1.1.2 | Inland cliff – basic | High | 6 | |
| I1.4.1 | Other exposure - acid/neutral | Moderate | 4 | |
| I1.4.2 | Other exposure - basic | Moderate | 4 | |
| I1.5 | Cave | Moderate | 4 | |
| I2.1 | Quarry | High/moderate/low/ none | 6/4/2/0 | Re-allocate these areas based on the habitats present and score accordingly. |
| I2.2 | Spoil | None | 0 | |
| I2.3 | Mine | High/moderate/low/ none | 6/4/2/0 | Re-allocate these areas based on the habitats present and score accordingly. |
| I2.4 | Refuse-tip | None | 0 | - |
| J1.1 | Cultivated/ disturbed land - arable | Moderate/low | 4/2 | Where uncultivated field margins are present these areas should be split off and classified as of moderate distinctiveness. All other arable or un-vegetated ground should be classified as being of low distinctiveness. |
| J1.2 | Cultivated/ disturbed land - amenity grassland | Low | 2 | |
| J1.3 | Cultivated/ disturbed land - ephemeral/ short perennial | High/moderate/low | 6/4/2 | Areas which form part of an open mosaic habitat on previously developed ground (a habitat of principal importance) should be identified as of high distinctiveness. Other stands should be classified as moderate or low distinctiveness based on the species present. |
| J1.4 | Introduced shrub | Low | 2 | |
| J2.8 | Earth bank | Low | 2 | |

| Phase 1 code | Habitat description | Distinctiveness | Weighting | Guidance |
|---|---|---|---|---|
| J3.4 | Caravan site | High/moderate/low/none | 6/4/2/0 | Re-allocate these areas based on the habitats present and score accordingly. |
| J3.6 | Buildings | Low | 2 | |
| J4 | Bare ground | Low | 2 | |
| J5 | Other habitat | High/moderate/low/none | 6/4/2/0 | Based on habitats and species present. |
| N/A | Roads and other hardstanding | Low | 0 | |

# Annex E: Electromagnetic interference– technical note

1.1.1 The following technical note is appended to this document:

- Electromagnetic interference

# HS2 London-West Midlands

# Technical note - Electromagnetic interference (EMI)

## A report to HS2 Ltd by Arup/URS

# Contents



**List of figures**

**List of tables**

# 1 Electromagnetic interference (EMI)

## 1.1 Introduction

1.1.1 The purpose of this technical note is to provide guidance to undertake the assessment of the likely effects of electromagnetic interference (EMI) generated by the construction and operation of the Proposed Scheme.

1.1.2 Electric and magnetic fields are produced wherever electricity is used. The electric field is produced by voltage and the magnetic field by current. Electromagnetic fields (EMF) cause two types of effect;

- interference to electric and electronic equipment. This is called electromagnetic interference (EMI) and is the disturbance that affects an electrical system due to magnetic and electric fields, electromagnetic induction or electromagnetic radiation emitted from an external source; and
- the potential to cause harmful effects in the human body through EMF.

1.1.3 Electromagnetic compatibility (EMC) is the ability of equipment to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbance to other equipment in that environment

1.1.4 This technical note considers the principal sources of EMI and EMF from the Proposed Scheme that may have an effect on third parties along the route, in particular from the traction power supply system. Emissions from the rolling stock, signalling and communication systems, electrical and mechanical systems, generally only affect the internal railway operating system and are therefore not considered further as having a wider potential effect.

1.1.5 There is also a requirement to address the EMF exposure, and the possible risk from exposures of the general public and workers to electric fields, magnetic fields and electromagnetic fields generated by the Proposed Scheme, in line with current UK Government recommendations.

## 1.2 Legal context

1.2.1 The Electromagnetic Compatibility Directive[1] 2004 has been incorporated in the UK as Statutory Instrument 3418:2006[2]. The UK regulations require that equipment shall be so designed and manufactured, having regard to the state of the art, as to ensure that:

- the electromagnetic disturbance generated does not exceed the level above which radio and telecommunications equipment or other equipment cannot operate as intended; and
- it has a level of immunity to the electromagnetic disturbance to be expected in its intended use which allows it to operate without unacceptable degradation of its intended use.

[1] Official Journal of the European Union, (2004), *The Electromagnetic Compatibility Directive 2004/108/EC*.
[2] *The Electromagnetic Compatibility Regulations* 2006. Her Majesty's Stationery Office.

1.2.2 A fixed installation shall be installed applying good engineering practices and respecting the information on the intended use of its components. With regard to the Proposed Scheme, the scope of the assessment is concerned with emissions from the Proposed Scheme only and will be installed with a view to meeting the requirements set out in bullet point 1 of paragraph 1.2.1.

1.2.3 A fixed installation is defined as a particular combination of several types of apparatus and where applicable, other devices, which are assembled, installed and intended to be used permanently at a predefined location.

1.2.4 The railway network and its components (e.g. a signalling system) are considered to be a fixed installation under the terms of the regulations.

1.2.5 An electrified railway has the potential to introduce additional risks through the generation of EMF, which has the potential to effect human health and interfere with electronic equipment. In addition the transmission of high voltage electricity can induce potentially harmful voltages into adjacent cables, metallic structures and the human body. It is these risks that will affect third parties external to the railway and are to be considered in producing the Environmental Impact Assessment (EIA).

1.2.6 For EMF exposure of the general public and workers, the reference levels based on short-term effects are found within the International Commission on Non-Ionising Radiation Protection (ICNIRP) guidelines[3] for limiting exposure to time varying electric, magnetic, and electromagnetic fields (1Hz to 100kHz) 2010. The limits within these guidelines will consider:

- occupational exposure; applicable to non-residential premises; and
- public exposure; applicable to residential premises.

1.2.7 For the assessment, the generic immunity standards will be applied i.e. BS EN 61000-6-1:2007. Electromagnetic compatibility Part 6.1: Generic standards- immunity for residential, commercial and light industrial environments and BS EN 61000-6-2:2005. Electromagnetic compatibility Part 6.2: Generic standards- immunity for industrial environments.

1.2.8 Immunity for residential, commercial and light industrial environments will be referred to as 'residential' within this technical note.

1.2.9 The Proposed Scheme will be built to comply with the BS EN 50121 series of standards, Railway Applications, Electromagnetic Compatibility, which contains the following parts;

- BS EN 50121-1:2006 Part 1: General[4];
- BS EN 50121-2:2006 Part 2: Emissions of the whole railway system to the outside world[5];
- BS EN 50121-3-1:2006 Part 3-1: Rolling stock - train and complete vehicle[6];

[3] ICNIRP, (2010), *Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (1Hz to 100 kHz).*
[4] BSI, (2006), *BS EN 50121-1:2006. Railway applications - Electromagnetic compatibility Part 1: General.*
[5] BSI, (2006), BS EN 50121-2:2006. *Railway applications - Electromagnetic compatibility Part 2: Emissions of the whole railway system to the outside world.*
[6] BSI, (2006), BS EN 50121-3-1:2006. *Railway applications - Electromagnetic compatibility Part 3-1: Rolling stock - train and complete vehicle.*

- BS EN 50121-3-2:2006 Part 3-2: Rolling stock – apparatus[7];
- BS EN 50121-4:2006 Part 4: Emissions and immunity of the signalling and telecommunications apparatus[8]; and
- BS EN 50121-5:2006 Part 5: Emissions and immunity of fixed power supply installations and apparatus[9].

1.2.10 The set of standards in 1.2.9 are intended to permit compliance to the EMC Directive, but also provides a means of prescribing compatibility between the internal parts of the railway. These standards identify maximum limits of electromagnetic disturbance at the railway boundary, which is defined as 10m from the centre of the nearest track (BS EN 50121-1).

1.2.11 The Proposed Scheme will also comply with the BS EN 50122 series of standards, Railway Applications - Fixed installations - Electrical safety, earthing and the return circuit, which consists of:

- BS EN 50122-1:2011 Part 1: Protective provisions against electric shock[10];
- BS EN 50122-2:2010 Part 2: Provisions against the effects of stray currents caused by d.c. traction systems[11]; and
- BS EN 50122-3:2010 Part 3: Mutual Interaction of a.c. and d.c. traction systems[12].

1.2.12 In addition the following standards are applicable:

- BS EN 50499:2008 Procedure for the assessment of the exposure of workers to electromagnetic fields and covers the essential requirements of the proposed EMF Directive[13];
- EC Recommendation 1999/519/EC on the limitation of exposure of the general public to electromagnetic fields (0Hz to 300GHz), provides levels for public exposure to EMF[14]; and
- The Railways (Interoperability) Regulations 2011[15].

1.2.13 The European Parliament published Directive 2013/35/EU[16] in June 2013 and is closely based on the ICNIRP guidelines. It replaces the earlier 2004 Directive[17], which was

[7] BSI, (2006), BS EN 50121-3-2:2006. *Railway applications - Electromagnetic compatibility Part 3-2: Rolling stock – apparatus.*
[8] BSI, (2006), BS EN 50121-4:2006. *Railway applications - Electromagnetic compatibility Part 4: Emissions and immunity of the signalling and telecommunications apparatus.*
[9] BSI, (2006), BS EN 50121-5:2006. *Railway applications - Electromagnetic compatibility Part 5: Emissions and immunity of fixed power supply installations and apparatus.*
[10] BSI, (2011), BS EN 50122-1:2011. *Railway Applications - Fixed installations - Electrical safety, earthing and the return circuit. Part 1: Protective provisions against electric shock*
[11] BSI, (2006), BS EN 50122-2:2010 - *Railway applications. Fixed installations. Electrical safety, earthing and the return circuit. Provisions against the effects of stray currents caused by d.c. traction systems*
[12] BSI, (2006), BS EN 50122-3:2010. *Railway applications. Fixed installations. Electrical safety, earthing and the return circuit. Mutual Interaction of a.c. and d.c. traction systems.*
[13] BSI, (2008), BS EN 50499:2008. *Procedure for the assessment of the exposure of workers to electromagnetic fields.*
[14] Official Journal of the European Union, (1999), *EC Recommendation 1999/519/EC on the limitation of exposure of the general public to electromagnetic fields (oHz to 300GHz)*
[15] *The Railways (Interoperability) Regulations 2011.* Her Majesty's Stationery Office..
[16] Official Journal of the European Union, Directive 2013/35/EU on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields)
[17] Official Journal of the European Union, Directive 2004/40/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields)

never implemented. The UK Government will bring the Directive into effect through the Health and Safety Executive in the form of a set of EMF Regulations that will take three years to produce. When it is released it will be evaluated against any proposals that are produced for the EIA, for any additional changes that may be required. It is likely that that by the time of construction and operation of the Proposed Scheme, more stringent standards will apply.

## 1.3 Requirements

1.3.1 The requirements for EMC will be met throughout the life of the Proposed Scheme by adhering to the guidelines, technical specifications and industry best practice at the design, installation, test and commissioning stages.

1.3.2 To assist with the environment assessment, baseline data will be collected and evaluated to assess the vulnerability of the existing environment against the effects of the Proposed Scheme and its operation. This will be undertaken as a desk-top study.

# 2 Scope and methodology

## 2.1 Electromagnetic risk

2.1.1 An electrified railway has the potential to introduce additional EMI and EMF risks through the generation of electromagnetic fields, which have the potential to effect human health and interfere with electronic equipment. In addition the transmission of high voltage electricity can induce potentially harmful voltages into adjacent cables, metallic structures and the human body.

2.1.2 Emissions from the signalling and communication systems, electrical and mechanical systems, generally only affect the internal railway operating system and are not considered in this analysis.

2.1.3 Power supplies used for construction are generally not sufficient to cause major EMI or EMF problems. Tunnel boring machines, generally use a high voltage supply for their operation, typically 11kV three phase. The levels of EMF emissions are generally insufficient to cause any adverse effect.

2.1.4 Due to the construction corridor that will be acquired to build the Proposed Scheme, most buildings that would be potentially at risk will be demolished. It is not therefore, anticipated that any electromagnetic impact on humans is expected. Some buildings may remain close to the Proposed Scheme and there may be risk of interference for some sensitive electrical equipment or equipment in residential properties.

2.1.5 EMI and EMF issues during operation of the Proposed Scheme will be limited to those caused by the traction current within the overhead line electrification system. Emissions from rolling stock, signalling and other electrical infrastructure such as trackside non-traction electrical distribution, are not high enough to cause effects outside the railway boundary.

2.1.6 There is existing data, from HS1 for example, that can be used to illustrate the minimal effects of EMI and EMF to the environment.

## 2.2 Areas at risk

2.2.1 An electrified railway has the potential to affect the operation of susceptible equipment adjacent the railway. Examples of potential sensitive sites that may be at risk and are to be considered are:

- universities;
- schools;
- hospitals;
- military establishments;
- airports;
- emergency and commercial radio stations;
- residential properties; and
- industrial properties.

2.2.2 Magnetic fields generated by current flowing within the overhead traction distribution, have the potential to cause harmful effects in the human body.

2.2.3 Power lines and other aerial cable routes that run parallel to the railway for any significant distance may be affected by induced voltages from the overhead line electrification system if placed too close together.

2.2.4 Other services such as underground pipelines are susceptible to induced voltage, if they are metal and run parallel for any significant distance.

## 2.3 Secondary areas

2.3.1 Where overhead power lines and their supporting structures have to be moved as a result of the Proposed Scheme, an assessment of the effect of the moved power line will be undertaken, to ensure that it does not introduce any EMI or EMF that is detrimental to its new surroundings.

2.3.2 The National Grid in its publication Development near overhead lines[18] indicates that magnetic fields generated by 275/400kV overhead power lines are in the order of 4 microTesla (μT) at 10m from the centreline of the route. It is therefore unlikely that moving an existing power line will have any significant effect.

2.3.3 Changes to the route of the National Grid will be undertaken in accordance with their own environmental and planning standards and procedures.

## 2.4 Data collection

2.4.1 A desk-top survey of the route will be undertaken to identify any potentially sensitive sites within a 50m corridor either side of the centreline of the nearest HS2 Phase One track, or from the proposed power equipment, e.g. overhead lines and traction substations.

[18] National Grid, (2008), *Development near overhead lines - Planning and amenity aspects of high voltage electricity transmission lines and substations.*

2.4.2 The primary causes of EMI and EMF will come from the traction power distribution and overhead line electrification. The extent of any interference or harmful effects will be limited to only a short distance from the railway boundary or the boundary of any traction power substation or switching station. A 50m corridor is to be selected to identify all potential receptors within that area to demonstrate that the level of risk will be limited to a much shorter distance from the railway. Any receptor outside of the 50m corridor will not be affected.

2.4.3 Preliminary traction power modelling has been undertaken, which has identified potential electromagnetic emissions data throughout the route. This preliminary EMF data has formed the baseline against which to identify those receptors that may be at risk. The Proposed Scheme will comply with BS EN 50121, which limits the maximum EMF at the railway boundary.

2.4.4 The identification of possible third party receptors to EMI and EMF will be done by mapping and analysing the alignment route(s) using the construction drawings for the applicable area, or the alignment map if these are not available. From this information, third party receptors that fall within the 50m corridor either site of the centreline of the nearest track and also the proposed power equipment, e.g. overhead lines and traction substations will be identified.

2.4.5 Typical receptors will include (but is not limited to); residential zones, industrial zones, schools, hospitals, emergency services, military establishments, radio transmitters, mobile phone masts, the current National Grid infrastructure and existing railways.

2.4.6 Potential receptors in buildings that are to be demolished to make way for the Proposed Scheme will no longer be receptors once the Proposed Scheme is operational and are therefore not included in the assessment.

2.4.7 Although a 50m corridor has been selected, the effects of EMI can extend further afield in cases of services running parallel for any significant distances, causing induced voltages. Any such services (National Grid overhead power lines, motorway telecommunication systems, oil and gas pipelines etc.) are to be included in the data collected.

2.4.8 If construction drawings are not available i.e. individual track positions are not available, identify those third party receptors that fall within a 60m corridor either site of the centreline of the route.

2.4.9 An element of professional judgement must be applied whether to include receptors that fall just outside of the 50m or 60m rule.

2.4.10 Other than items identified in 2.4.7, any receptor outside the 50m should not be affected and need not be considered as part of this assessment.

2.4.11 Three types of potential receptors shall be recorded:

- locations that could contain electrical equipment that may be susceptible to EMI;
- locations where people are located that may be affected by EMF; and

- adjacent equipment that may be susceptible to induced currents for example; overhead cables, parallel telecommunications cables, pipelines or metal fencing.

2.4.12 Once each site has been identified, an assessment will be undertaken to categorise the perceived level of risk and to identify the potential mitigation for each site.

2.4.13 Data will be collected to identify potential receptors at risk. Not all data will be presented within the ES, only those deemed to be at risk. The data collected will be kept to demonstrate an extensive search. The data will be tabulated for each type of receptor at risk, showing:

- an identification number;
- its location along the route, in kilometres;
- distance from the centre of the nearest track;
- the receptor; house, industrial unit, hospital, school etc.;
- the receptor type; industrial, residential, railway, overhead power line etc.;
- the reference that defines the immunity limit;
- immunity limit;
- estimated emission level;
- is there an EMI/EMF risk (yes or no);
- mitigation measures; and
- other comments.

2.4.14 From the information identified in 2.4.13, only significant risks will be listed within Volume 5 of the ES (refer to Volume 5: Appendix EM-001-000). As many of the EMF/EMI risks will be mitigated through the design, installation, operation and maintenance of the Proposed Scheme. Risks to be identified for the ES are:

- residential, commercial and light industrial receptors sufficiently close to the proposed scheme that may be susceptible to EMI. Where these are identified, they will be subject to further assessment at detailed design stage. Table A1 in Appendix A will include EMI receptors within 20m of the nearest track, although some of these may not be at risk due to their particular situation e.g. sufficiently below a viaduct such that the EMI is expected to be below 3 Amperes per metre (A/m);
- in exceptional cases, where receptors are sufficiently close to the Proposed Scheme such that the plots in Appendix B do not provide sufficient resolution to conclude that there is no EMF risk to particular receptors (typically, within 10m from the centreline of the nearest rail), Table A2 in Appendix A will include these receptors, which will be further assessed at detailed design stage; and

- infrastructure identified in 2.4.7 which runs parallel to the Proposed Scheme for over 2km and within 200m. This infrastructure may be at risk of induced voltages, which can be mitigated through adherence to applicable standards at the design and installation stages. These receptors will be presented in Table A3 in Appendix A.

## 2.5 Emission levels

2.5.1 The preliminary results of the traction power modelling show anticipated levels of EMF as contour plots. These plots are reproduced within Appendix B of this document and show key points from the centreline of the railway. The worst case values of EMF will be used in determining the level of risk, which will depend on the receptor location in relation to track level, i.e. in a cutting, on an embankment or viaduct, or in a tunnel.

2.5.2 In any case, the Proposed Scheme will comply with BS EN 50121, which limits the maximum EMF at the railway boundary to below ICNIRP levels.

2.5.3 The relationship between magnetic flux density (B, measured in μT) and magnetic field strength (H, measured in A/m) is given as:

$$B = 1.256H$$

2.5.4 Outside the railway boundary, the levels of radiated electric fields generated from the traction power will not exceed the 5kV/m threshold within the ICNIRP guidelines and will have no adverse effect on human health. It will not therefore be considered further in this assessment. This has been established from the preliminary traction power modelling.

2.5.5 Results from the preliminary modelling estimates a maximum induced voltage per unit length of approximately 30V/km at 20m from the centre of the nearest track. From this data there is therefore the potential for any conductor within 20m exceeding the 60V touch threshold if it ran parallel to the Proposed Scheme for over 2km. Similarly, between 20m and 50m from the centre of the nearest track, there is risk of induced voltages of over 60V where parallel running is over 3km.

2.5.6 Motorways that run parallel for a significant distance, typically more than 2km and up to 500m separation, may have telecommunication lines that could be susceptible to induced voltages. The induced voltage limits for telecommunication lines are recorded in the International Telecommunication Union Directive ITU-T Volume VI[19]. For there to be induced voltages, the motorway would have to have continuous metal cable, which is unlikely.

## 2.6 Risk assessment

2.6.1 The risk assessment will consider the following potential risks against each establishment or location:

- health immunity from the effects of power frequency magnetic fields;
- equipment immunity from the effects of radio frequency electric fields and power frequency magnetic fields; and

[19] International Telecommunication Union, ITU-T Directives, concerning the protection of telecommunication lines against harmful effects from electric power and electrified railway lines: Volume IV Danger, damage and disturbance.

- effects of induced voltages and other effects.

## Health immunity

2.6.2 The effects of magnetic fields will be assessed against the limits in ICNIRP for electromagnetic exposure to workers and the general public. For exposure compliance, extrapolated magnetic fields will be compared with the ICNIRP reference levels. The magnetic field levels will be taken from the contour plots that are contained within Appendix B of this document.

2.6.3 The plots indicate less than 10μT level of EMF at distances of between 7-10m from the centreline of the nearest track. This level is significantly lower than the 200μT ICNIRP recommendation for general public exposure.

2.6.4 ICNIRP identifies the reference level for short term exposure, which are the only guidelines set by the UK Government. There are no standards applicable to long term effects. The risk arising from long-term, low level of magnetic field exposure to children is not assessed here as although ICNIRP acknowledges research in this area, it concludes that "a causal relationship between magnetic fields and childhood leukaemia has not been established nor have any other long term effects been established."

## Electrical interference

2.6.5 The plots indicate a 4A/m (equivalent to 5μT) level of emissions at approximately 15m from the centre of the nearest track. This level is above the 3A/m limit for residential immunity specified in BS EN 61000-6-1[20]. Therefore residential receptors within 20m of the centre of the nearest track are considered to be potentially at risk from EMI.

2.6.6 The 20m distance identified in 2.6.5 is dependent on the receptor being at the same level as the railway. If the Proposed Scheme is on a viaduct, embankment or in a cutting this would affect the level of risk and should be taken into account when identifying receptors at risk.

2.6.7 Exceeding the reference level does not necessarily mean that the prescribed basic restrictions have been exceeded. Where reference levels have been exceeded then mitigation measures will be provided. The prediction of potential interference at this point in time is based on the preliminary traction power modelling. Further models will be generated during detailed design to facilitate further assessment. In some cases, interference may not be known until the testing and commissioning stage, where further mitigation may be necessary. The preliminary modelling is based on worst case levels of generated EMF, which appear as peak levels that may be experienced for very short periods of time.

2.6.8 There may be residual effects for people with active medical implants, including pacemakers, where the EMC immunity performance of the active medical implant is less than the immunity performance specified in applicable harmonised standards.

[20] BSI, (2007), *BS EN 61000-6-1:2007. Electromagnetic compatibility Part 6.1: Generic standards- immunity for residential, commercial and light industrial environments.*

2.6.9 The effects of EMI will be assessed against the limits in BS EN 61000-6-1 and BS EN 61000-6-2[21]. Table A4 IN Appendix A summarises the limits for both magnetic and electric immunity.

### Other effects

2.6.10 The effects of induced voltages are mitigated by adherence to British, European Standards and industry best practice throughout the design, installation, operation and maintenance phases.

2.6.11 Similarly, any effects on other railways will be mitigated through adherence to British, European Standards and industry best practice throughout the design, installation, operation and maintenance phases. Studies undertaken previously on similar railway projects, suggest that the risk posed by a new electrified railway is well within recommended limits and that the risk of EMI is only confined to the railway infrastructure.

### Wildlife

2.6.12 The published studies addressing the risk of EMF to wildlife shows little or no evidence of a significant environmental impact. From current information the exposure limits in the ICNIRP guidelines for protection of human health are also protective of wildlife.

## 2.7 Mitigation

2.7.1 Management and control of EMI will be assured by following the process defined within those standards and by adopting best practice for design, installation, maintenance and operation. In particular:

- compliance with the UK EMC Regulations 2004/108/EC[22] and UK Statutory Instruments 2006 No3418[23];
- application of harmonised standards BS EN 50121, BS EN 50122 and BS EN 61000 series of standards;
- comply with applicable Technical Specifications for Interoperability; and
- application guidance of Network Rail (NR) code of practice NR/L2/RSE/30041[24], which although is not applicable to the Proposed Scheme, is an example of best practice.

### EMF and human health

2.7.2 It is extremely unlikely that the levels of EMF will exceed those recommended in ICNIRP; even the closest of receptors will be subjected to emissions below 5% of the acceptable ICNIRP levels.

2.7.3 For public access where bridges pass over or under the Proposed Scheme, the level of EMF exposure may be higher than that at ground level, however it is unlikely to reach maximum threshold. The level of exposure is also likely to be of a transient and short term nature (e.g. crossing a bridge in a vehicle or on foot).

[21] BSI, (2005), *BS EN 61000-6-2:2005. Electromagnetic compatibility Part 6.2: Generic standards- immunity for industrial environments.*
[22] DTI, (2006), *Implementing the new Electromagnetic Compatibility (EMC) Directive 2004/108/EC in the United Kingdom.*
[23] The Stationery Office, (2006), *The Electromagnetic Compatibility Regulations No3418.*
[24] Network Rail, (2012), *NR/L2/RSE/30041 Electromagnetic Compatibility Assurance Process. Issue 2, dated 2 June 2012.*

2.7.4 It is therefore expected that in most cases no mitigation against EMF will be required, as the ICNIRP threshold limits will not be exceeded.

2.7.5 There may be exceptional cases where receptors are sufficiently close to the Proposed Scheme such that the plots in Appendix B do not provide sufficient resolution to conclude that there is no EMF risk to particular receptors. These receptors will be included in Table A2 and they will be further assessed at detailed design stage. Specifically this may affect the HS1 to HS2 link, however the traction load here will be considerably less than on other sections of the route and there is unlikely to be any significant effect.

## Electromagnetic interference

2.7.6 Potential mitigations against significant EMI issues for receptors affected by the Proposed Scheme include:

- relocation of the receptor to a location where the impact is reduced below accepted limits;
- emission control from the Proposed Scheme;
- screening; and
- increase the immunity of the receptor (replace equipment designed for residential immunity with that designed for industrial immunity).

2.7.7 It is expected that EMI risks may only affect residential receptors within 20m from the centreline of the nearest track or industrial receptors with very sensitive electrical or electronic equipment. Where identified, these receptors will be further evaluated during the detailed design stage of the project and further mitigation taken, which may be in the form of replacement of equipment with less sensitive equipment.

## Induced voltages and other effects

2.7.8 In addressing the impact of the route running alongside, over or under an existing railway, mitigation will be met by meeting the requirements of both BS EN 50121 and BS EN 50122 suite of standards for design, construction, operation and maintenance. The design solutions will have to be agreed with the railway owner at the detailed design stage though consultation.

2.7.9 Induced voltages are mitigated by separation, screening or earthing and bonding. Metallic pipes and conduits that are within 60m from the railway and run parallel for more than 200m can be bonded to earth electrodes at intervals at no greater than 200m. This is in accordance with the NR standard NR/SP/ELP/21085[25], which although not applicable to the Proposed Scheme is an example of best practice. Such solutions will be discussed with the infrastructure owner at the design stage for agreement.

2.7.10 Where there is parallel operation with an existing motorway for a significant length, typically exceeding 2km, a review is required to be undertaken at the design stage and in discussion with the motorway owner to agree mitigation in accordance with existing British and European Standards and industry best practice.

[25] NR/SP/ELP/21085 Electromagnetic compatibility (EMC) assurance process, Network Rail publication.

### Construction

2.7.11 Mitigation against any specific construction issues will be addressed during the design. It will be the responsibility of the installation contractor to manage these issues on site.

2.7.12 High voltage supplies for construction machinery, especially for tunnel boring machines will not emit EMF at harmful levels.

2.7.13 Construction machinery and plant, and associated communications (e.g. construction radios) will comply with the applicable standards for EMF and EMC, for example Machinery Directive 2006/42/EC[26]. Therefore when installed, operated and maintained correctly, the risk of this apparatus producing EMF exceeding published limits for workers and the public or causing EMI is considered to be low.

2.7.14 All other electrical equipment used for construction will conform to the EMC Directive and should not cause any adverse effects.

2.7.15 It is therefore expected that no mitigation against EMF or EMI will be required for construction.

## 2.8 Cumulative effects

2.8.1 The likely cumulative effects of the Proposed Scheme running alongside an existing railway electrified at 25kV are unknown at this point in time. The electrification design of the Proposed Scheme is not sufficiently developed to make an accurate prediction. In undertaking the assessment of likely receptors the cumulative effects have assumed to be the addition of the respective EMF strengths at any particular point from the railway. The results from the preliminary traction modelling show that the maximum level of EMF at a point 20m from the centre of the nearest track is less than 1.5% of the ICNIRP limit for residential receptors. It is highly unlikely that any cumulative effect will come anywhere near to the ICNIRP level and will be discounted for this assessment.

2.8.2 The cumulative level of EMI resulting from running alongside an existing electrified railway may lead to exceeding the recommended 3A/m residential limit identified in BS EN 61000-6-1:2007. Interference at this level is not always certain; other factors can affect the outcome. Where this occurs, individual tests can be undertaken to assess the level of interference once the Proposed Scheme is energised. For the purpose of the risk assessment, those receptors that are within 20m of centreline of the nearest track, are to be considered at risk.

2.8.3 It is unlikely that any cumulative effect will exceed the 30A/m industrial limit identified in BS EN 61000-6-2:2005 and will be discounted for this assessment.

## 2.9 Climate change

2.9.1 The levels of generated EMF and EMI are dependent on the traction power, which has been calculated for a worst case scenario based on the maximum trains running per hour. Any change in climate is unlikely to affect the output from the traction power and cause any significant increase in EMF or EMI and will be discounted for this assessment.

[26] European Commission, (2006), *EU Directive 2006/42/EC on machinery.*

## 2.10 Significance

2.10.1 The Environmental Statement (ES) must identify all significant risks and it is therefore necessary to describe the level of significance for each type of risk. For EMF and EMI, these are described in this section 2.10.

2.10.2 The limit recommended by ICNIRP for short term effects of EMF general public exposure is 200 μT, for occupational exposure is 1000μT. According to the preliminary modelling results, the maximum level of EMF estimated outside of the railway boundary (i.e. between approximately 7-10m from the centre of the nearest track) is less than 10μT or 5% of the acceptable limit. The level of significance for EMF is therefore regarded as negligible.

2.10.3 The immunity level specified in BS EN 61000-6-1:2007 for significant electromagnetic interference to occur in residential properties is 3A/m. Any value above this is significant; however the effects of EMI on residential electrical or electronic equipment would be classed as moderate; defined as, "limited impact (by extent, duration or magnitude) which may be considered to be potentially significant".

2.10.4 From the preliminary modelling results, only residential properties up to 20m from the centreline of the nearest track are to be considered at risk from EMI.

2.10.5 Similarly, the immunity level specified in BS EN 61000-6-2:2005 for significant electromagnetic interference to occur in industrial properties is 30A/m. The preliminary modelling results show that this figure is unlikely to be exceeded and therefore the significance of EMI on industrial properties is therefore regarded as negligible.

2.10.6 Where there is an impact on an existing railway, overhead power line, motorway telecommunication systems or metallic services running parallel with the Proposed Scheme, all issues will be mitigated through design, installation, operation and maintenance to current British, European Standards and industry best practice. Such design solutions will be developed though consultation with the infrastructure owner. As a result, effects of EMF or EMI on these systems can be disregarded for the purpose of reporting in the ES.

## 2.11 Results

2.11.1 Receptors at risk of EMI are to be included within the table of results, which will go into Volume 5 of the ES (refer to Volume 5: Appendix EM-001-000). Such receptors will be limited to residential properties within 20m from the centreline of the nearest track.

2.11.2 Exceptional cases of receptors at risk of EMF will be included within the table of results.

2.11.3 Consideration will be given to the position of the receptor relative to the Proposed Scheme as this may affect the risk.

2.11.4 Where the Proposed Scheme runs in a tunnel, receptors within 20m are unlikely to be affected. Similarly where the Proposed Scheme runs on a viaduct, embankment or in a cutting the level of EMI may be less than for an equivalent receptor at grade.

2.11.5 Infrastructure identified in 2.4.7 which runs parallel to the Proposed Scheme for over 2km and within 200m are to be included within the table of results.

2.11.6 Tabulated examples are shown in Tables A1, A2 and A3.

# Appendix A: Tables

Table A1: Example of tabulated results (for EMI receptors that are within 20m from the centre of the nearest track)

| **Electromagnetic Compatibility Assessment (Equipment Immunity to Traction Power Frequency Magnetic Fields)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ID Number | Railway Chainage km + m | Distance from nearest track centre (m) | Sensitive installation | Receptor | Reference | Immunity limit (A/m) | Estimated emission level | Is there an EMI risk? (Y/N) | Mitigation measures | Comments |
| A1 | 148+250 | 10 | School | Residential | BS EN 61000-6-1<br>BS EN 61000-6-2 | 3 | >3A/m | Y | Replace with less sensitive equipment | Undertake another review once the Proposed Scheme is operational and replace equipment only then |
| A2 | 148+550 | 15 | Machine factory | Heavy Industrial | BS EN 61000-6-1<br>BS EN 61000-6-2 | 30 | <30A/m | N | N/A below recommended levels | The Proposed Scheme in cutting |
| A3 | 149+050 | 20 | House | Residential | BS EN 61000-6-1<br>BS EN 61000-6-2 | 3 | <3A/m | N | N/A below recommended levels | The Proposed Scheme on embankment |
| A4 | 149+550 | 15 | Retail Unit | Light Industrial | BS EN 61000-6-1<br>BS EN 61000-6-2 | 3 | >3A/m | Y | Replace with less sensitive equipment | The Proposed Scheme on embankment.<br>Undertake another review once the Proposed Scheme is operational and replace equipment only then |

Table A2: Example of tabulated results (for exceptional EMF receptors that are within 10m from the centre of the nearest track)

| **Electromagnetic Field Exposure Assessment (Health Immunity)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ID Number | Railway Chainage km + m | Distance from nearest track centre (m) | Sensitive installation | Receptor | Reference | Immunity limit (µT) | Estimated emission level | Is there an EMF risk? (Y/N) | Mitigation measures | Comments |
| B1 | 1+250 | 5 | House | Residential | ICNIRP | 200 | >7.47µT | unclear | Undertake further review at detailed design stage | The Proposed Scheme on existing viaduct |
| B2 | 1+650 | 5 | House | Residential | ICNIRP | 200 | >7.47µT | unclear | Undertake further review at detailed design stage | The Proposed Scheme on existing viaduct |

Table A3: Example of tabulated results (for other receptors that run parallel to the Proposed Scheme for over 2km and within 200m)

| **Electromagnetic Compatibility Assessment (Induced Voltages and other effects)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ID Number | Railway Chainage km + m | Distance from nearest track centre (m) | Sensitive installation | Receptor | Reference | Immunity limit (μT) | Estimated emission level | Is there an EMI risk? (Y/N) | Mitigation measures | Comments |
| C1 | 147+900 to 149+180 | 200 | 275/400kV Grid overhead line route | Power line | Potential induced voltages. HS2 EMC Strategy Document | | | N | Earthing and bonding to current standards | Unlikely to cause significant induced voltages, distance from track centre too great. |
| C2 | 148+800 to 152+000 | 50 | The Proposed Scheme runs parallel to existing Birmingham Coventry 25kV electrified railway | Railway | BS EN 50121 suite of standards apply as does BS EN 50122 | | | Y | Earthing and bonding to current standards | Design solutions to be agreed with the asset owner. |
| C3 | 166+300 to 168+900 | 50-150 | Buried BP Pipeline | Metal pipe line | Potential induced voltages. HS2 EMC Strategy Document | | | Y | Earthing and bonding to current standards | Design solutions to be agreed with the asset owner. |
| C3 | 166+310 to 168+320 | 100-200 | The Proposed Scheme runs parallel to M42 motorway | Motorway telecoms cables | Potential induced voltages. HS2 EMC Strategy Document | | | N | Earthing and bonding to current standards | Unlikely to cause significant induced voltages, length of parallelism below limit. |

Table A4: Assessment limits at 50Hz, taken from ICNIRP, BS EN 61000-6-1 and BS EN 61000-6-2

| **Basis of Limit** | **Units** | **Public Limit** | **Occupational Limit** |
|---|---|---|---|
| Electric fields, limit based on public health considerations | kV/m | 5 | 10 |
| Magnetic fields, limit based on public health considerations | μT | 200 | 1000 |
| EMC recommendations. Magnetic interference with any electronic equipment:<br>Residential, commercial and light industrial limits<br>Industrial limits | <br><br>A/m<br>A/m | <br><br>3<br>30 | |

# Appendix B: EMF contour plots

1.1.1 The following plots have been produced from the preliminary traction power modelling undertaken by HS2.The plots show worst case values of EMF along the route. The data cursors indicate the magnetic flux density at distances of about 10 m, 15 m, 20 m and 30 m from the centre line of the nearest track and are measured in microTesla (µT).

Figure B1: EMF Contour Plot -Line km 17.5

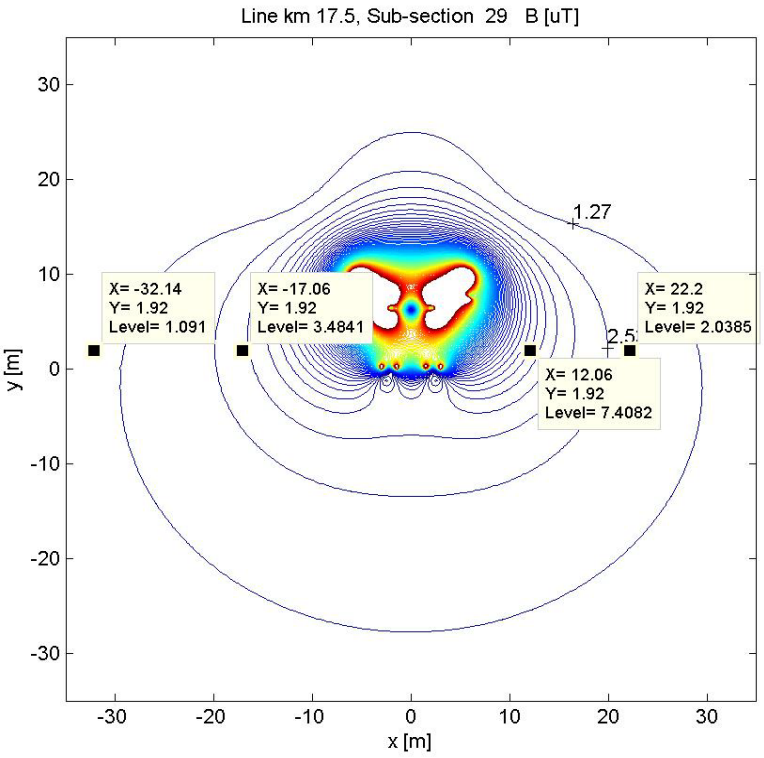



Figure B2: EMF Contour Plot Line km 21.5

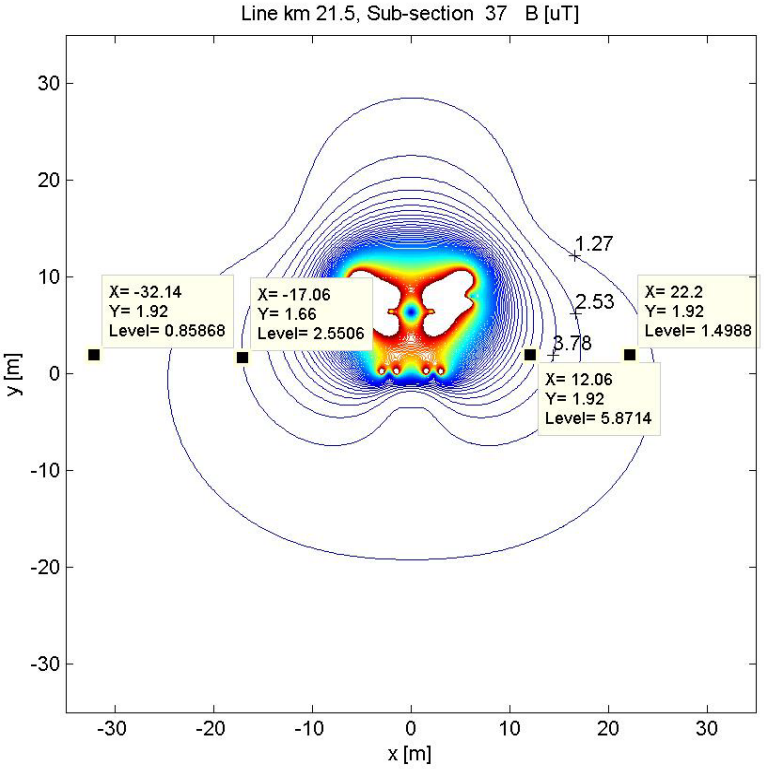


Figure B3: EMF Contour Plot Line km 24

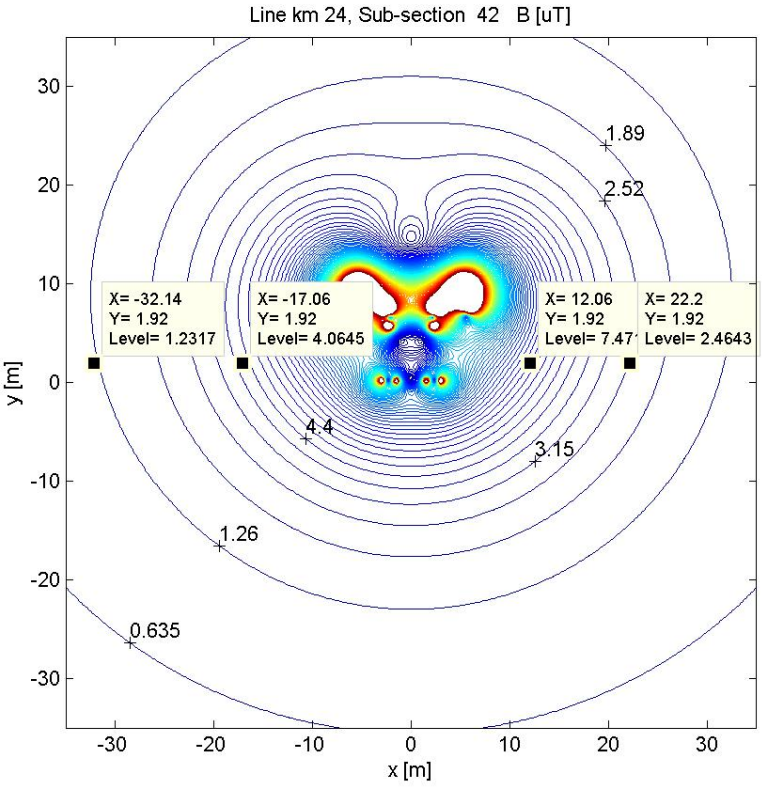



Figure B4: EMF Contour Plot Line km 27.5

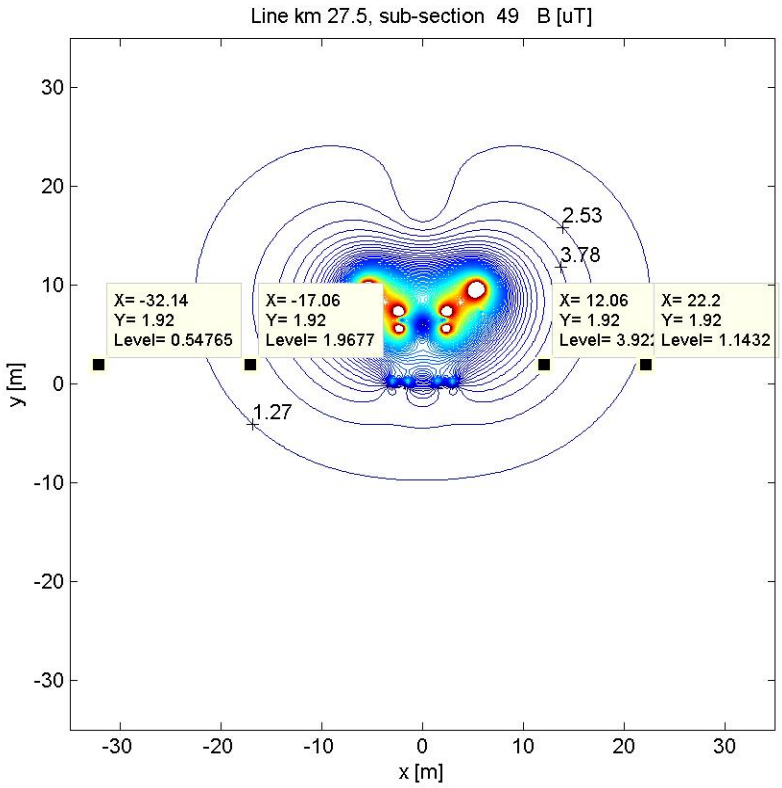


Figure B5: EMF Contour Plot Line km 32.5

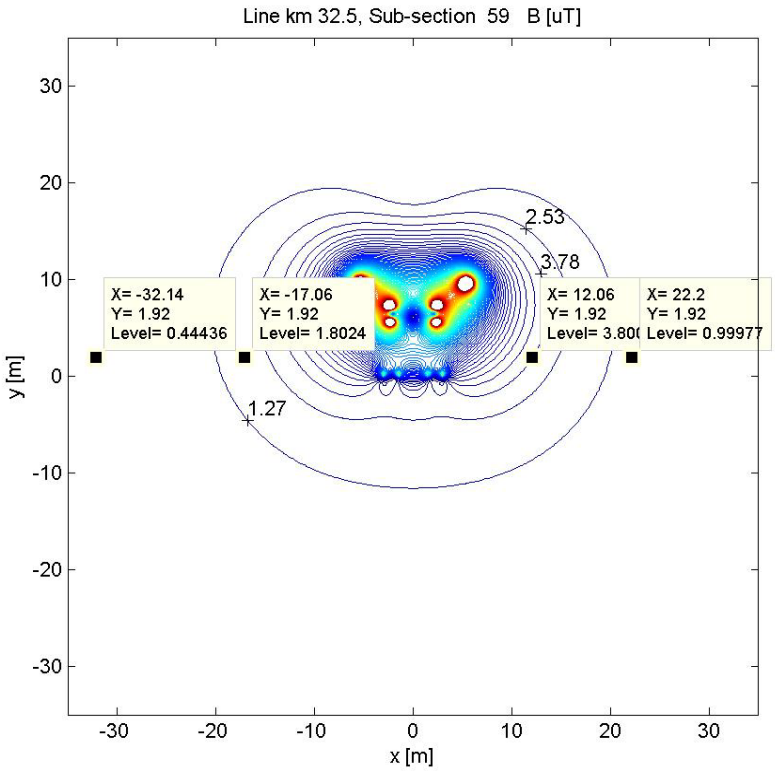



Figure B6: EMF Contour Plot Line km 41.5

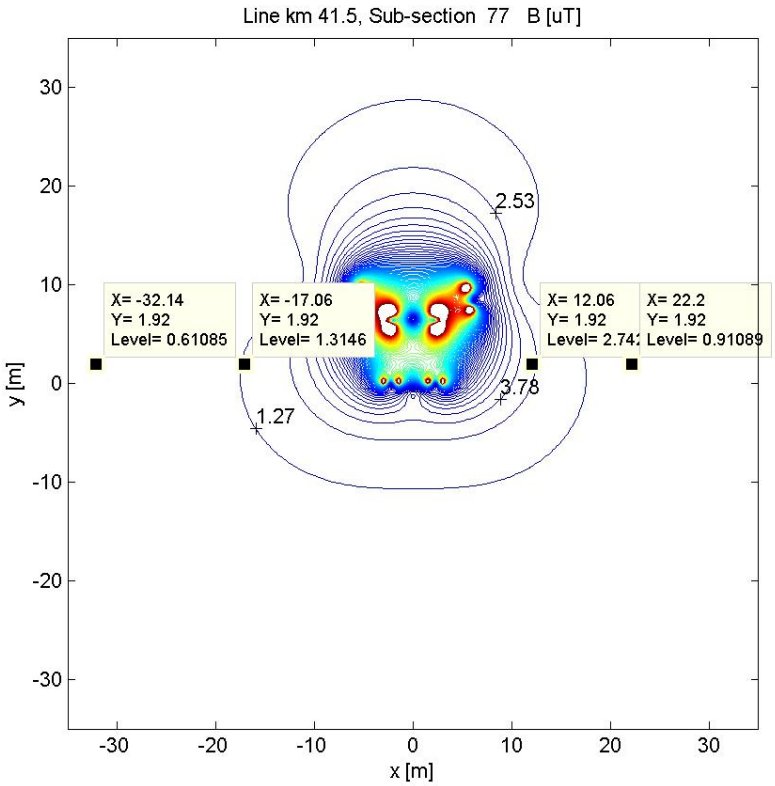
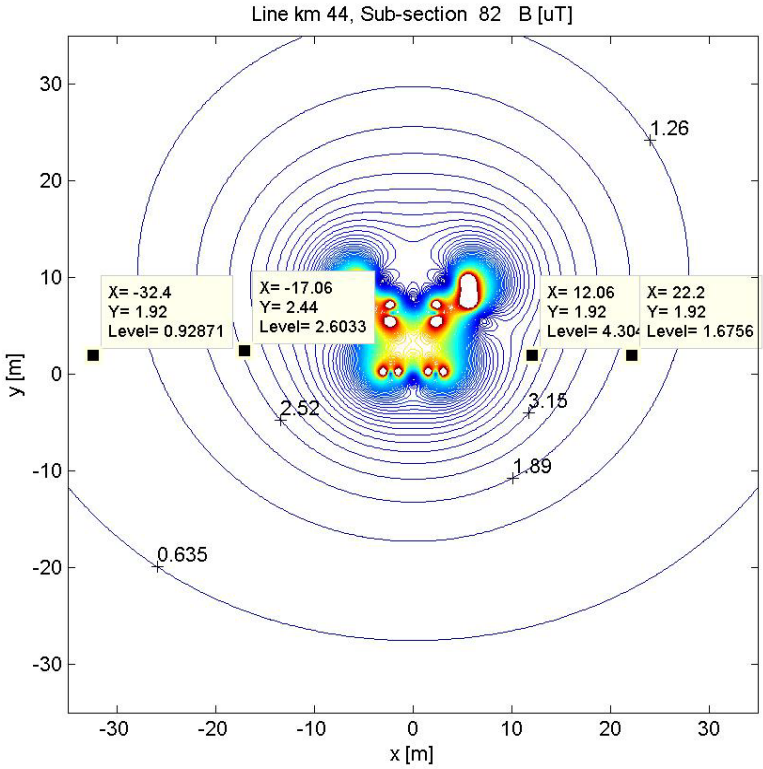


Figure B7: EMF Contour Plot Line km 44



# Annex F: Land quality – technical notes

1.1.1 The following technical notes are appended to this document:

- Introduction to land quality assessments
- Detailed methodology for land contamination assessments
- Methodology and significance criteria for geological issues (excluding land contamination)
- Operational issues
- Potential mitigation measures

# HS2 London-West Midlands

# Land quality

# Technical note – Introduction to land quality assessment

## A report to HS2 Ltd by Arup/URS

# Contents

**List of tables**

# 1 Introduction

1.1.1 The land quality assessment considers the quality of the land that the Proposed Scheme will pass over or through, and the resources that the soil or rocks contain. It considers several principal issues, including:

- the presence of existing contamination along or close to the Proposed Scheme that may be disturbed by the construction or operation of the Proposed Scheme;
- the presence of mining or mineral resources that may be sterilised or otherwise adversely affected; and
- the presence of geo-conservation resources that may be destroyed or their integrity otherwise affected.

1.1.2 In addition, the construction and operation of the Proposed Scheme may give rise to potential contaminative effects. For example, from operations at construction sites during the construction of the Proposed Scheme and work at the main depot sites during the operational period.

1.1.3 The land quality assessment identifies those areas or sites along or near to the Proposed Scheme that may have existing contamination present on them. It assesses the potential significance of the contamination, with respect to construction of the Proposed Scheme, and indicates whether specific mitigation may be required during the construction period to contain or remediate the contamination to allow safe construction, and to reduce post construction risks to an acceptable level. It outlines the types of remedial works that may be necessary at certain locations.

1.1.4 The assessment also identifies the scale of any impacts on geological, geomorphological, mineral and mining resources, and estimates the significance of the effects that the construction and operation of the Proposed Scheme may have on these resources in the future.

1.1.5 Finally it identifies the potential for contamination arising from the construction and operation of the Proposed Scheme, and sets out the operational mitigation measures that will be undertaken to minimise this risk.

# 2 International and national legislation, policy and guidance

## 2.1 National EIA guidance on land quality issues

2.1.1 There is no national legislation or policy specifically for the assessment of land quality within an Environmental Impact Assessment (EIA). However, within the UK, the assessment of land or groundwater in general is underpinned by Part IIA of the Environmental Protection Act[1] and subsequent guidance that has been issued to support the Act.

2.1.2 There are a number of national guidance documents on EIA which touch on land quality issues, such as:

- Environmental Impact assessment- A handbook for Scoping Projects[2]; and
- Assessment and Management of Environmental Effects. Highways Agency Design Manual for Roads and Bridges[3].

## 2.2 Contaminated land

### Planning guidance

2.2.1 Until April 2012, the principal guidance document relating to land quality was PPS23 Land Contamination and Pollution[4], particularly Annex 2 on Contaminated Land. However, in April 2012 PPS 23 was replaced by the National Planning Policy Framework[5] (NPPF), which is considerably more generalised in nature.

2.2.2 One of the NPPF core planning principles encourages the effective use of land by promoting reuse of previously developed (brownfield) land, provided that it is not of high environmental value. Therefore the NPPF envisages that the planning system should contribute to conserving and enhancing the natural environment by remediating and mitigating despoiled, degraded, derelict, contaminated and unstable ground where appropriate. However, to prevent unacceptable risks to human health and the environment, a new development should be appropriate for its location and, after treatment where necessary, suitable for its new use. After remediation, land should not be capable of being determined as 'contaminated land' under Part IIA of the Environmental Protection Act (1990).

2.2.3 In order to assess risks from contamination, site investigation data needs to be presented during the planning stage. This data should as a minimum contain desk study information and a site reconnaissance. This procedure will be followed as far as possible in this assessment.

[1] Her Majesty's Stationery Office, London, (1990), Environmental Protection Act (1990).
2 Environmental Agency, (2002), Environmental Impact Assessment; A Handbook for Scoping Projects.
3 Highways Agency, (2008), Design Manual for Roads and Bridges, Assessment and Management of Environmental Effects. HA205/08 Volume 11, Section 2, Part 5.
4 HMSO (2004), Planning Policy Statement 23: Planning and Pollution Control.
5 Department for Communities and Local Government (2012), *National Planning Policy Framework*.

## Contamination risk assessment guidance

2.2.4 There are two complementary systems in the UK for dealing with issues of land contamination. Part IIA of the Environmental Protection Act of 1990 set up a system of control by regulators (either the local authority in the case of human health risks and/or the Environment Agency, which in any case deals separately with Controlled Water risks) who could deal with issues of ongoing contamination of sites within their boundaries by determining land as 'contaminated land' and, if necessary, by issuing a 'remediation notice' to the responsible person (usually the owner or occupier of the site in the absence of the original polluter) to enforce investigation and remediation.

2.2.5 Secondly, for those sites that enter the planning and redevelopment process, the regulator will normally require the developer to undertake sufficient assessment of the site to show whether the site is contaminated or not, and if so, to design, undertake and to verify adequate remediation as part of the development. Each stage of the process needs to be agreed with the regulator(s). With respect to the identification, assessment and remediation of contaminated land and groundwater there is a considerable body of knowledge that has been built up over the last 20 or so years, principally by the Environment Agency, Defra, Construction Industry Research and Information Association (CIRIA) and Contaminated Land: Applications in Real Environment (CL:AIRE). The most relevant documentation to a design stage assessment of contaminated land is CLR11 Model Procedures for the Management of Contaminated Land[6]. This sets out the procedures to be undertaken at various stages of a project on land affected by contamination. The Environmental Impact Assessment occurring as it does, at the initial stages of a project, equates, in general, to the definition of the preliminary risk assessment within CLR11.

2.2.6 Detailed guidance is given within various Environment Agency and Defra documents, which deal with the detailed risk assessment of sites once direct intrusive ground investigation has been undertaken and the detailed scope and nature of contaminants and the immediate environment is understood.

2.2.7 The primary method by which contaminants in soil are assessed is the Contaminated Land Exposure Assessment (CLEA) methodology[7]. This methodology has been prepared by the Environment Agency and sets out the science and assumptions by which critical criteria for contaminants can be estimated for different end-use scenarios and in different soils. A set of criteria, using the most onerous assumptions, are encapsulated within the Soil Guideline Values[8] (SGVs), also published by the Environment Agency.

2.2.8 The primary method by which contaminants in controlled waters are assessed is the methodology published within the Environment Agency document Remedial Targets Methodology 2006[9].

2.2.9 The primary method of assessing the risks to designated ecological receptors from contaminants is contained within a suite of Environment Agency documents (An ecological risk assessment framework for contaminants in soil[10] and associated

[6] Environment Agency (2004), *Model Procedures for the Management of Land Contamination. CLR11.*
[7] Environment Agency (2009), *Updated technical background to the CLEA model. Science report SC050021/SR3.*
[8] Environment Agency (2009), *Using Soil Guideline Values.Science Report SC050021/SGV Introduction.*
[9] Environment Agency *(2006), Remedial Targets Methodology.*
[10] Environment Agency (2008), *An ecological risk assessment framework for contaminants in soil.*

guidance documents). It sets out a three-tiered risk assessment process that is designed to establish whether pollutant linkages between contamination and ecological receptors exist, and to gather sufficient information for making decisions on whether harm to those receptors could occur.

2.2.10 The primary method by which ground gasses are assessed is the CIRIA report C665 Assessing risks posed by hazardous ground gasses to buildings[11]. The methodology includes information on how best to monitor ground gasses over an interval of time, how to interpret the results and what mitigation measures to design to prevent ground gasses entering buildings. Additional information is contained in the British Standard BS8485:2007 Code of practice for the characterization and remediation from ground gas of affected developments[12].

2.2.11 Below ground concrete (e.g. building foundations) are at risk from various chemical species within the ground, primarily types of sulphates. The sulphates are often naturally occurring, but can also be present as a result of pollution. The assessment and mitigation of this risk is considered as part of the geotechnical assessment of the Proposed Scheme, and is not considered within the Environmental Statement.

2.2.12 The result of applying risk assessment methodologies will determine which contaminants in which areas pose a significant risk to which receptors as a result of the construction of the Proposed Scheme. Rational decisions can then be made on the detailed extent and type of mitigation and/or remediation methods applied.

2.2.13 In choosing particular remediation methods, a number of factors come into play including:

- the type or types of contamination;
- their extent;
- the types of soils they are contained within;
- the time period for remediation;
- the site size and other logistical constraints; and
- the sustainability of the various remedial options.

2.2.14 An options appraisal process is usually undertaken to identify the option or options that would be most appropriate and these would then comprise the remedial strategy for the site.

## 2.3 Mining, mineral and geological resources

2.3.1 There is no particular national guidance on assessing geological, mining or mineral resources for EIA purposes.

[11] CIRIA, (2007,) *Assessing risks posed by hazardous gasses to buildings. Report C665.*
[12] British Standards BS8485, (2007), *Code of practice for the characterisation and remediation from ground gas affected developments.*

# 3 Assessment methodology

## 3.1 Introduction

3.1.1 The land quality topic contains several differing strands of assessment. There is not a single assessment methodology that can be used for the varying sub-topics. Therefore, detailed methodologies have been developed for each sub-topic, based on current best practise and guidance. A summary of these assessment methodologies is set out in this Section. They are given in detail in other technical notes appended to the SMR addendum Annex F: Detailed methodology for land contamination assessments and Methodology and significance criteria for geological issues (excluding contaminated land)

3.1.2 All methodologies are based on the source-pathway-receptor concept, whereby in order to have an environmental effect, there needs to be:

- a source (e.g. of contamination) which can impact a receptor;
- a pathway (between the source and receptor); and
- a receptor or receptors (which may have a varying sensitivity to the impacts from the source).

## 3.2 Scope

3.2.1 The study area used in the assessment of land quality is the area of land required to construct the Proposed Scheme together with a buffer extending out for a minimum of 250m, but in the case of groundwater data up to 1km. Areas of land required for the Proposed Scheme, but which will entail no or minimal ground disturbance (eg utility diversions within highways and existing remote train stabling areas) have not been assessed.

3.2.2 The impact of existing land contamination during the construction stage has been considered. Any significant existing contamination will be remediated during the construction process; therefore it is not considered further during the operational stage of the project.

## 3.3 Sources of information

3.3.1 Sources of information for contamination issues, mining and mineral issues, and geological conservation issues are shown in Tables 1, 2 and 3.

Table 1: Sources of information for contamination issues

| Source of information | Type of information |
|---|---|
| Envirocheck Report | Historical mapping, landfill and other waste management activities, surface and groundwater data, pollution control data, Radioactive Substance Act data, previous and current industrial land uses, and hazardous substances planning data. |
| Local Authorities | Supplementary information on landfills, underground petrol tanks, previous investigation data, potential and/or determined contaminated land sites. |
| Environment Agency | Supplementary information on landfills, and surface water/groundwater. |
| Defra | Animal burial sites. |

| Source of information | Type of information |
|---|---|
| British Geological Survey (BGS) | Basic geological mapping (1:10,000 and 1:50,000), specialist mapping, memoirs, borehole logs from BGS borehole database. |
| Network Rail | Previous ground investigation data. |
| Ministry of Defence | Information on current and former Ministry of Defence land. |
| Other archive resources | For example in house investigation data, information from waste disposal companies. |
| Current/historical air photos | Where required, to supplement historical mapping (being flown by HS2). |

Table 2: Sources of information for mining and mineral issues

| Source of Information | Type of Information |
|---|---|
| Coal Authority | Details of previous, current and potential future opencast and underground coal mining. |
| Local authorities | Planning designations regarding mineral extraction. |
| Mineral extraction companies | Supplementary information. |

Table 3: Sources of information for geological conservation issues

| Source of Information | Type of Information |
|---|---|
| Natural England | Data on geological or geomorphological Sites of Special Scientific Interest (SSSI). |
| Local authorities | Data on Local Geological Sites or other local geological conservation sites. |
| Geo-Conservation UK | Data on Local Geological Sites or other local geological conservation sites. |

## 3.4 Site inspections

3.4.1 In addition to 'familiarisation visits', following collection of data, site visits will be required to confirm some of the data collected (particularly from key sites). Such visits may require:

- access to Network Rail land;
- access to private land for which access permission will be required; and/or
- access to public land (e.g. highways, public footpaths, amenity land etc).

3.4.2 Because access to private land requires permission, which may not always be granted, access to certain areas may not be available during the preparation of the Environmental Statement.

## 3.5 Existing land contamination

3.5.1 The methodology for assessing existing potential land contamination along the Proposed Scheme is set out in detail in the technical note Detailed Methodology for land contamination assessment (appended to the SMR addendum - Appendix F). Essentially the process consists of three stages:

- a screening process whereby all potential areas of land contamination identified from the data collected, are assessed against criteria including land

use, the proximity of receptors, the proximity of the potential land contamination to the Proposed Scheme, the nature of construction etc. A scoring system for the screening process identifies those areas that potentially pose a contaminative risk for the Proposed Scheme;

- for these areas, a more detailed risk assessment process, which assesses the risks of potential contamination (using a source-pathway-receptor methodology) and assesses the qualitative degree of risk that they are likely to pose is undertaken; and
- finally, consideration is given to the effects that remediation or mitigation of the contamination will have at each of these areas, and whether this will lead to a longer term beneficial effect (because of containment or removal of contamination).

3.5.2 Both during the screening process and the risk assessment process, where potentially contaminated sites are likely to give rise to the same types of risks, they can be grouped and considered together, where appropriate.

3.5.3 Potential mitigation measures (including contamination remediation) are described in the technical note 'Potential mitigation measures' (appended to the SMR addendum - Appendix F). It is the intention to treat and re-use as much contaminated soils as possible within the Proposed Scheme. The most likely form of mitigation measures to be used will include the following methodologies.

3.5.4 Bio-Remediation: Excavation and placing of contaminated soils in bio-piles or windrows, followed by aeration, and where required, addition of composting materials, nutrients and microbial inocula. This technique is useful for remediation of hydrocarbon contamination. Treatability studies are generally required and remediated soil can be usually re-used on site following treatment.

3.5.5 Soil Stabilisation: Excavation and batch treatment of soil with additives such as lime, cement and other proprietary materials to alter the physico-chemical characteristics of the soil, to reduce the leachability of contaminants within the soil and/or reduce the permeability of the soil. Stabilisation is useful for a wide range of contaminants, both organic and inorganic, but significant areas are required for stockpiling of untreated and treated soils. Treatability studies are generally required and remediated soil can be re-used on site following treatment. Stabilisation may be required independently for geotechnical purposes.

3.5.6 Soil Washing: Excavation and batch or continuous treatment of soils to remove contaminants (or the soil matrix that contains the contaminants). In practice the finer particles (clays and silts) with contaminants adhered to them are separated from the coarser particles (sands and gravels) which can then be re-used. Wash water can be recycled, but contaminated residues may need to be disposed of at a landfill site. It can be used on soils with a wide range of contaminants, but the soils themselves need to have a reasonably high proportion of re-usable granular materials (>70%) for the process to be economic.

3.5.7 Cover systems and vertical cut-offs: Contaminated soils are left in the ground and the pollutant linkage broken by placing a cover system on top of the contaminated soil and/or providing a cut-off around the contaminated soil. Cover systems most often

comprise clay systems sometimes accompanied by geotextiles, capillary break systems etc. Alternative geo-synthetic clay systems are also used. Vertical cut-offs can include bentonite, concrete or sheet steel barriers. No remediation trials are generally necessary and they can be installed quickly. However, contaminants are not removed or destroyed.

3.5.8 Some contaminated materials are not amenable to treatment and re-use, and will need to be disposed of off-site.. Such materials may include asbestos containing materials (ACM), radioactive materials and recent domestic waste.

3.5.9 Ground gas control: ground gas migration can be controlled by vertical and/or horizontal cut-offs together with controlled venting to the atmosphere. In some cases the removal of gas generating material (eg recent domestic waste) may also be required.

3.5.10 Groundwater remediation: there are a wide number of groundwater remediation methodologies. Where groundwater receptors are not immediately at risk monitored natural attenuation (MNA) can be undertaken, whereby the contaminated groundwater is monitored on a regular basis to confirm that natural processes are acting to degrade and disperse the contaminants within the groundwater. Where receptors are at risk, contaminants in the groundwater can be treated using a variety of methods including soil flushing, volatilization, chemical reduction and bio-treatment.

## 3.6 Construction issues

3.6.1 At construction compounds, there will be a variety of materials and liquids being stored, handled and used during the construction period. There is, therefore a risk that such materials could give rise to soil or groundwater contamination through spillage or leakage.

3.6.2 In these locations, consideration will be given to the types of operations that would be undertaken, the types of contaminative materials or liquids that would be used or stored (for example fuel oils), and the types of safeguards (mitigation measures) that would be required in order that such materials or liquids would not give rise to significant soil or groundwater contamination. This process has informed the development of environmental management protocols for construction compounds (for example, specific measures within the draft Code of Construction Practice).

## 3.7 Operational issues

3.7.1 The main potential operational sources of contamination will be derived from maintenance works at the Infrastructure Maintenance Depot (IMD), located at Calvert in Buckinghamshire and at the Rolling Stock Maintenance Depot (RSMD) located at Washwood Heath in Birmingham.

3.7.2 In these locations, consideration will be given to the types of operations that will be undertaken, the types and volumes of contaminative materials or liquids that will be used or stored (for example fuel oils), and the types of safeguards (mitigation measures) that will be required in order that such materials or liquids will not give rise to significant soil or groundwater contamination.

## 3.8 Mining, mineral and geological resources

3.8.1 Existing mining and/or mineral sites, together with the areas or sites that are likely to be considered as future mining or mineral areas have been identified through review of desk study data as set out in Tables 1-3. These are usually designated as mineral safeguarding areas in county council or unitary authority mineral plans, and indicate that for any planning applications submitted within those areas, there is a need to consider conflicts with the mineral extraction requirements for the county.

3.8.2 The methodology for assessing the effects of the Proposed Scheme on current and future mining and mineral resources is contained in detail in the technical note 'Methodology and significance criteria for geological issues (excluding land contamination') - appended to the SMR addendum, which sets out a method to assess the value of a resource and the magnitude of impact that it will experience, to determine whether there are significant effects.

3.8.3 Where significant effects are determined, then mitigation measures will be required to reduce or offset the impacts. Such measures for geological resources may include, for example, prior use of the resource before construction of the Proposed Scheme or, in the case of severance providing additional or alternatives accesses to working sites. In the case of a geo-conservation resource, mitigation may include the creation of a similar geo-conservation site in the near vicinity which replicates the geological features of interest.

3.8.4 Further details regarding mitigation measures are contained within the technical note 'Potential mitigation measures'

## 3.9 Significance criteria

3.9.1 The significance criteria for contaminated land issues, mining and mineral issues and geo-conservation issues are set out in technical note's Detailed methodology for land contamination assessments' and 'Methodology and significance criteria for geological issues (excluding land contamination') and also below in Tables 4 and 5.

Table 4: Significance criteria for land contamination

| Significance Criteria | Definition |
|---|---|
| Major adverse effect | An increase in contamination risk of 4 or 5 risk levels in the risk matrix, e.g. from land that has a very low contamination risk in the baseline becomes a high or very high risk. |
| Moderate adverse effect | An increase in contamination risk of 2 or 3 risk levels in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk. |
| Minor adverse effect | An increase in contamination risk of 1 risk level in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate/low risk. |
| Negligible effect | No change in contaminated land risks. |
| Minor beneficial effect | A reduction in contamination risk of 1 risk level in the risk matrix, e.g. land that has a moderate/low contamination risk in the baseline becomes a low risk. |
| Moderate beneficial effect | A reduction in contamination risk of 2 or 3 risk levels in the risk matrix, e.g. land that has a high contamination risk in the baseline becomes a moderate/low or low risk. |
| Major beneficial effect | A reduction in contamination risk of 4 or 5 risk levels in the risk matrix, e.g. land that has a very high contamination risk in the baseline becomes a low or very low risk. |

Table 5: Significance criteria for mining/mineral and geological resources

| Term | Description |
|---|---|
| Major adverse | Considerable detrimental or negative impact (by extent, duration or magnitude) of more than local importance or in breach of recognised standards, policy or legislation. Always considered significant. |
| Moderate adverse | Limited detrimental or negative impact (by extent, duration or magnitude) which may be considered to be significant. |
| Minor adverse | Slight, very short or highly localised detrimental or negative impact without a significant consequence. |
| Negligible | Imperceptible impact to an environmental resource or receptor |
| Minor beneficial | Slight, very short or highly localised advantageous or positive impact without a significant consequence. |
| Moderate beneficial | Limited advantageous or positive impact (by extent, duration or magnitude) which may be considered to be significant |
| Major beneficial | Considerable advantageous or positive impact (by extent, duration or magnitude) of more than local importance or in breach of recognised standards, policy or legislation. Always considered significant. |

## 3.10 Assumptions and limitations

3.10.1 The assessment will primarily be based on existing documentation (such as historical mapping, geological mapping and a variety of reports) supplemented by site visits. In a number of areas, generally in the Birmingham and London areas, previous ground investigation data may also be available to assist in the assessments. Project specific ground investigation will not be undertaken.

3.10.2 Considerable use is made of historical Ordnance Survey mapping to identify previous uses of land. There is the possibility that short term contaminative land uses may not be shown on mapping if it only occurred for a brief period between two subsequent mapping editions.

# HS2 London-West Midlands

# Land quality

# Technical note – Detailed methodology for land contamination assessments

## A report to HS2 Ltd by Arup/URS

# Contents



**List of tables**



**List of appendix tables**

# 1 Introduction

## 1.1 General

1.1.1 This technical note presents the proposed detailed methodology for the assessment of existing potential land contamination for the Proposed Scheme. It is based primarily on the assessment of potential sources of contamination identified from current and historical mapping, site inspections where possible and other documentary data made available (for example, information held by local authorities). It includes:

- categorisation of sources;
- categorisation of potential receptors;
- assessment of pathways;
- assessment of potential impacts on sensitive receptors; and
- assessment of environmental effects.

1.1.2 The technical note deals with the assessment of existing potential land contamination. It does not deal with any contamination potentially derived from the operation of the Proposed Scheme (see Operational issues appended to the SMR addendum Annex F), nor with other land quality issues, such as geo-conservation issues (see Methodology and significance criteria for geological issues (excluding land contamination), appended to the SMR addendum Annex F.

1.1.3 The study area for the assessments includes the land required to construct the Proposed Scheme together with a buffer extending out for a minimum of 250m, except in the case of groundwater when a limit of up to 1Km may be considered.

1.1.4 The process used generally follows the procedures outlined in the Environment Agency Report CLR 11 Model Procedures for the Management of Land Contamination[1].

## 1.2 Layout of Report

1.2.1 Section 2 of this technical note deals with the screening methodology proposed. The screening aims to pre-identify those sites with potential sources of contamination that could have a significant impact on the construction of the Proposed Scheme, and, thereby on the surrounding environment. These sites will be taken through to a more detailed assessment.

1.2.2 Section 3 describes the more detailed assessment applied to these sites. It is essentially a conventional contaminated land risk assessment employing a conceptual site model (CSM) to identify the various types of risk present at the site. The more detailed assessment will be undertaken for baseline (i.e. pre-construction), construction and post construction stages. The construction stage assessment assumes that normal construction mitigation measures (as stated in the draft CoCP see Volume 5: Appendix CT-003-000) will be applied during the construction work.

[1] Environment Agency (2004), *Model Procedures for the Management of Land Contamination.*

The post-construction assessment assumes that appropriate remedial measures have been undertaken during the construction phase.

1.2.3 Contamination risks at baseline will then be compared to risks at the construction stage and the post-construction stage. Where the risk has increased (for example during the construction stage) then an adverse effect will be recorded. Where the risk has decreased (for example as a result of the remediation of contamination), then a beneficial effect will be recorded.

# 2 Screening

## 2.1 Stage A

2.1.1 The screening process is divided into two stages (A and B). Six steps are involved in Stage A:

- divide the Proposed Scheme into lengths showing similar vertical alignment (see Table A1 in Appendix A).;
- divide the area either side of the Proposed Scheme into proximity zones (see Table A2 In Appendix A);
- review mapping and identify potentially contaminative land uses and categorisation (see Table A3 in Appendix A), giving each a unique reference number;
- review landfill information and other land use information and identify any additional potentially contaminative land uses and categorisation, giving each a unique reference number;
- apply impact potential scoring (see Table A4 in Appendix A); and
- determine, from scoring, which sites to take through to Stage B.

2.1.2 The scoring system gives a score between 0 and 5 to each site, based on the type of potentially contaminated land, the proximity of the site to the Proposed Scheme and the vertical alignment.

2.1.3 Scores of 0 to 1 will require no further action. Scores of 3 and above will automatically go through to Stage B. For scores of 2 a sense check will be undertaken to decide whether further assessment is necessary.

## 2.2 Stage B

2.2.1 There are three further steps in Stage B:

- identify sensitive land uses locations in the study area (see table A5 in Appendix A);
- identify Principal and Secondary A aquifers in the study area; and
- based on impact potential scoring, apply the receptor proximity assessment as described in Paragraph 2.2.2.

2.2.2 All sites with an impact potential score of 5 will go forward for a detailed assessment, irrespective of receptor sensitivity. For sites with an impact potential score of 4, if contaminative land use is within 50m of a sensitive land use and overlies a Principal or Secondary A aquifer, then the site will go forward for detailed assessment. For sites with an impact potential score of 3 or 2, if contaminative land use immediately adjoins a sensitive land use and/or overlies a Principal or Secondary A aquifer, then the site will go forward to a more detailed assessment.

2.2.3 At each of the above stages professional judgement will need to be used to check that the screening system is highlighting the most significant sites.

# 3 Contamination Risk assessment

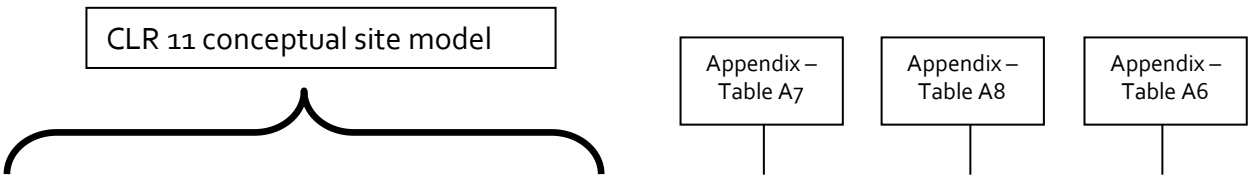
## 3.1 Stage C

3.1.1 There are two stages (C and D) to the more detailed risk assessment. The first stage has two steps:

- for each site, develop three (baseline, construction and post-construction) Conceptual Site Models (CSMs); and
- estimate the risk magnitude on the contaminant linkages that are considered to exist by assessing the probability (likelihood) of pollution/harm occurring and the consequence of that pollution/harm, through a qualitative risk assessment (see Tables 1 – 3). This is undertaken for the baseline, construction and post construction phases. The estimation of risk is undertaken using the matrix presented in Table A6 in Appendix A, together with the associated definitions in Tables A7 and A8.

3.1.2 The results of these two steps are presented in three CSMs as qualitative risk assessments (baseline, construction and post-construction). The construction and post construction risk assessments assume that appropriate mitigation will have been undertaken.

Table 1: Baseline CSM and Qualitative Risk Assessment




| Source | Receptor | Pathway | Probability | Consequence | Risk at baseline without mitigation |
|---|---|---|---|---|---|
| | | | | | |
| | Contaminant linkages | | | | |
| | | | | | |
| | | | | | |

Table 2: Construction CSM and Qualitative Risk Assessment

| Source | Receptor | Pathway | Probability | Consequence | Risk with construction stage mitigation |
|---|---|---|---|---|---|
| | | | | | |
| Contaminant linkages | | | | | |
| | | | | | |
| | | | | | |

3.1.3 Table 2 assumes standard construction mitigation practices presented in the draft COCP are applied.

Table 3: Post construction CSM and Qualitative Risk Assessment

| Source | Receptor | Pathway | Probability | Consequence | Risk with permanent works mitigation |
|---|---|---|---|---|---|
| | | | | | |
| Contaminant linkages | | | | | |
| | | | | | |
| | | | | | |

3.1.4 Table 3 assumes remediation has been undertaken and construction works completed.

## 3.2 Stage D

3.2.1 During Stage D, the significance of the effects of the contamination will be assessed by comparing the difference in risk of each contaminant linkage at baseline to those at construction and at post construction stages. This provides a way of assessing both the adverse and beneficial effects during construction and the post construction period. Table 4 provides a template of how this will be presented using the definitions in Table A7 in Appendix A. Where there has been a decrease in environmental risk, the scheme will be considered to have a beneficial effect on the environment in the long term (even though there may be adverse short term construction effects).

Table 4: Significance of Impact during construction and post construction

| Contaminant Linkage | Main Baseline Risks | Main Construction Risks | Main Post-construction Risks | Construction Effects Significance | Post-construction Effects Significance |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Overall Significance | | | | | |
| | | | | | |

# Appendix A: Screening and Contamination Risk Assessment Tables

Table A1: Classes of vertical alignment

| Code | Definition |
|---|---|
| V/E | Viaduct or embankment more than 1.5m high where main intrusion into ground will be from foundations of structures |
| C/S | Route at grade or in cuttings or cut and cover tunnels |
| T | Deeper bored tunnels, with no disturbance of surface features |

Table A2: Proximity zone definition

| **Zone no** | **Definition** |
|---|---|
| Zone 1 | All land on or within the footprint of the land required for the construction and operation of the Proposed Scheme and including a 10m margin either side of the centre line of the Proposed Scheme, and including side shoots such as road realignments, spoil borrow or storage areas etc |
| Zone 2 | All land within 50m of the edge of Zone 1 land |
| Zone 3 | All land from between 50 and 250m from the edge of Zone 1 land |

Table A3: Potentially Contaminative land uses

| **Class** | **Generic description** | **Typical land-uses** |
|---|---|---|
| Class 1 | Low risk of potential contamination, or less hazardous chemicals in use | |
| | | Farms |
| | | Warehouses |
| | | Goods yards |
| | | Hospitals |
| | | Builders yards |
| | | Retail and Business Parks |
| Class 2 | Medium risk of potential contamination, more hazardous chemicals in possible use | Engineering workshops |
| | | Conventional railways/disused railway lines |
| | | Brick works (by virtue of their potential backfill) |
| | | Dry Cleaners (retail) |
| | | Sewage works |
| | | Former clay pits and quarries |
| | | Cement/asphalt works |
| | | Car breakers |

| Class | Generic description | Typical land-uses |
|---|---|---|
| | | Garage workshops |
| | | Waste transfer facilities |
| | | Paper works |
| | | Power Stations |
| | | Glass works |
| | | Timber treatment works |
| | | Foot and mouth burials |
| | | Metal manufacturing and plating |
| | | Depots |
| | | Scrap yards |
| Class 3 | High risk of potential contamination, hazardous chemicals likely to be present | Gas and cokeworks |
| | | Landfills and historical landfills |
| | | Petrol filling stations |
| | | Oil Depots |
| | | Iron and Steel Works |
| | | Historical Foundries |
| | | Chemical Works |
| | | Tanneries |
| | | Asbestos Works |
| | | Dye Works |
| | | Animal processing and abbatoirs |
| | | Printers |
| | | Evidence of fuel/storage tanks |
| | | Dry Cleaners (industrial) |
| | | Printers (industrial) |
| | | |

Table A4: Impact potential scoring method

| Potentially contaminative Land-use Class (see Table 3) | Proximity to route (see Table 1 and below) | Vertical alignment (see Table 2 and below) | Impact potential score |
|---|---|---|---|
| Class 1 Low risk | Zone 1 | V/E | 2 |
| | | C/S | 3 |
| | | T | 0 |
| | Zone 2 | V/E | 1 |
| | | C/S | 2 |
| | | T | 0 |
| | Zone 3 | V/E | 0 |
| | | C/S | 1 |
| | | T | 0 |
| Class 2 Medium risk | Zone 1 | V/E | 3 |
| | | C/S | 4 |

| Potentially contaminative Land-use Class (see Table 3) | Proximity to route (see Table 1 and below) | Vertical alignment (see Table 2 and below) | Impact potential score |
|---|---|---|---|
| | | T | 2 |
| | Zone 2 | V/E | 2 |
| | | C/S | 3 |
| | | T | 2 |
| | Zone 3 | V/E | 1 |
| | | C/S | 2 |
| | | T | 1 |
| Class 3 High risk | Zone 1 | V/E | 4 |
| | | C/S | 5 |
| | | T | 3 |
| | Zone 2 | V/E | 3 |
| | | C/S | 4 |
| | | T | 3 |
| | Zone 3 | V/E | 2 |
| | | C/S | 3 |
| | | T | 2 |

Table A5: Sensitive Receptors

| List of land uses deemed "sensitive" | Sensitive water resources | Geological or Ecological designations | Property |
|---|---|---|---|
| Housing | Principal | SSSI | Mineral Resources (actual or with planning permission) |
| Schools | Secondary A | Ramsar | Building structures (for gas risks) |
| Public parks | Watercourses (Main River Status) | | Grade 1 Agricultural land |
| Playgrounds | | | |

Table A6: Estimation of Risk Magnitude

| | | Consequence | | | |
|---|---|---|---|---|---|
| | | Severe | Medium | Minor | Negligible |
| Probability | High Likelihood | 6 | 5 | 4 | 3 |
| | Likely | 5 | 4 | 3 | 2 |
| | Low Likelihood | 4 | 3 | 2 | 1 |
| | Unlikely | 3 | 2 | 1 | 1 |

Descriptions of classified risks are as follows:

## A1.1 6 (Very High Risk)

1.1.1 There is a high probability that a contaminant linkage could exist between a source and a designated receptor resulting in detriment to the receptor. Investigation and remediation will be required prior to (or as part of) construction. During construction further mitigation and monitoring measures (in accordance with the draft Code of

Construction Practice (CoCP)) are likely be required. Such sites are considered significant.

## A1.2 5 (High Risk)

1.2.1 It is likely that a contaminant linkage exists with potentially a severe affect on designated receptors. Investigation and remediation is very likely to be required. Such sites are considered significant.

## A1.3 4 (Moderate Risk)

1.3.1 It is possible that an effect could arise to a designated receptor through a contaminant linkage. However, the effect is most likely to be moderate to minor. Further investigative work is likely to be required to clarify the risk. Some remediation works may be required. Such sites may be considered significant.

## A1.4 3 (Moderate/Low Risk)

1.4.1 It is possible that a contaminant linkage could exist, but if it does, any effects would normally be minor. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.

## A1.5 2 (Low Risk)

1.5.1 It is a low possibility that a contaminant linkage could exist. However, should there be a linkage the effect to the receptor (with regards to controlled waters) would normally be minor or negligible and the effect on human health would be negligible. No investigation or remedial works are likely to be required.

## A1.6 1 (Very Low Risk)

1.6.1 It is unlikely that a contaminant linkage could exist between a source and a designated receptor.

Table A7: Classification of Probability

| Classification | Definition of the Probability of Harm/Pollution Occurring |
|---|---|
| High Likelihood | The contaminant linkage exists and it is very likely to occur in the short term, and/or will almost inevitably be realised in the long term, and/or there is current evidence of it being realised. |
| Likely | The source, pathway and receptor exist for the contaminant linkage and it is probable that this linkage will occur. Circumstances are such that realisation of the linkage is not inevitable, but possible in the short term and likely over the long term. |
| Low Likelihood | The source, pathway and receptor exist and it is possible that it could occur. Circumstances are such that realisation of the linkage is by no means certain in the long term and less likely in the short term. |
| Unlikely | The source, pathway and receptor exist for the contaminant linkage but it is improbable that it will be realised even in the long term. |

Table A8: Classification of Consequence

| Classification | Definition of Consequence |
|---|---|
| **Human Health Receptors – Site End Users** | |
| Severe | Acute damage to human health based on the potential effects on the critical human health receptor. |
| Medium | Chronic damage to human health based on the potential effects on the critical human health receptor. |
| Minor | Minimal short- term effects on human health based on the potential effects on the critical human health receptor. |
| Negligible | No appreciable impact on human health based on the potential effects on the critical human health receptor. |
| **Controlled Water Receptors** | |
| Severe | Pollution of a Principal aquifer within a source protection zone (inner and outer) or potable supply characterised by a breach of drinking water standards. Pollution of a surface water course characterised by a breach of an Environmental quality Standard ( EQS ) at a statutory monitoring location or resulting in a change in the General Quality Assessment (GQA) grade of river reach. Discharge of a hazardous or non-hazardous substance to groundwater. |
| Medium | Pollution of a Principal aquifer outside a source protection zone (inner and outer) or a Secondary A aquifer characterised by a breach of drinking water standards. Pollution of an industrial groundwater abstraction or irrigation supply that impairs its function. Substantial pollution but insufficient to result in a change in the GQA grade of river reach. |
| Minor | Low levels of pollution of a Principal aquifer outside a source protection zone or an industrial abstraction, or pollution of a Secondary A or B aquifer. Low levels of pollution insufficient to result in a change in the GQA grade of river reach, pollution of a surface water course without a quality classification. |
| Negligible | No appreciable pollution, or pollution of a low sensitivity receptor such as a secondary (undifferentiated) aquifer or a surface water course without a quality classification. |
| **Ecosystem Receptors** | |
| Severe | For sites with designations as follows – Site of Special Scientific Interest, National Nature Reserve, Special Protection Area (and potential sites), Special Area of Conservation (and candidate sites) or Ramsar. Irreversible adverse change in the functioning of the ecological system or any species of special interest that forms part of that system. |
| Medium | For sites with designations as follows – Site of Special Scientific Interest, National Nature Reserve, Special Protection Area (and potential sites), Special Area of Conservation (and candidate sites) or Ramsar. Substantial adverse change in the functioning of the ecological system or any species of special interest that forms part of that system. |
| Minor | Harm to ecosystems of a low sensitivity such as sites of local importance. No appreciable harm to ecosystems with statutory designations. |
| Negligible | Limited harm to ecosystems of low sensitivity such as sites of local importance. |
| **Property Receptors – Buildings, Foundations and Services including the operational HS2 scheme** | |
| Severe | Collapse of a building or structure including the services infrastructure from explosion due to ground gasses. |
| Medium | Significant damage to a building or structure including the services infrastructure impairing their function. |
| Minor | Damage to buildings/structures and foundations but not resulting in them being unsafe for occupation. Damage to services but not sufficient to impair their function. |
| Negligible | No appreciable damage to buildings/structures, foundations and services. |
| **Property Receptors – Grade 1 Agricultural land** | |
| Severe | Substantial loss in the value of crops or domestically-grown produce resulting from disease, death or other physical damage. Death to livestock, domesticated animals or wild animals subject to shooting or fishing rights. |
| Medium | Substantial diminution in yield of crops or domestically-grown produce resulting from disease, death or other physical damage. Serious disease or other serious physical damage to livestock, domesticated animals or wild animals subject to shooting or fishing rights. |
| Minor | Harm to crops but not resulting in a substantial loss in value or diminution in yield. Limited harm in terms |

| Classification | Definition of Consequence |
|---|---|
| | of disease or other physical damage to livestock, domesticated animals or wild animals subject to shooting or fishing rights. |
| Negligible | No appreciable harm, or harm to a low sensitivity receptor. |

Table A9: Significance Criteria

| Significance Criteria | Definition |
|---|---|
| Major adverse effect | An increase in contamination risk of 4 or 5 risk levels in the risk matrix, e.g. from land that has a very low contamination risk in the baseline becomes a high or very high risk. |
| Moderate adverse effect | An increase in contamination risk of 2 or 3 risk levels in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk. |
| Minor adverse effect | An increase in contamination risk of 1 risk level in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate/low risk. |
| Negligible effect | No change in contaminated land risks. |
| Minor beneficial effect | A reduction in contamination risk of 1 risk level in the risk matrix, e.g. land that has a moderate/low contamination risk in the baseline becomes a low risk. |
| Moderate beneficial effect | A reduction in contamination risk of 2 or 3 risk levels in the risk matrix, e.g. land that has a high contamination risk in the baseline becomes a moderate/low or low risk. |
| Major beneficial effect | A reduction in contamination risk of 4 or 5 risk levels in the risk matrix, e.g. land that has a very high contamination risk in the baseline becomes a low or very low risk. |

# HS2 London-West Midlands

# Land quality

# Technical note – Methodology and significance criteria for geological issues (excluding land contamination)

## A report to HS2 Ltd by Arup/URS

# Contents



**List of tables**

# 1 Introduction

1.1.1 This technical note explains the basis for the assessment of significance with regard to a number of geological issues, other than existing contaminated land (which is dealt with in a separate technical note - Detailed methodology for contaminated land assessment in the SMR Addendum, Annex F). The issues considered here include:

- geological conservation resources; and
- mining and mineral resources.

1.1.2 Geological conservation resources include geological and geomorphological Sites of Special Scientific Interest (SSSI), Local Geological Sites (previously known as Regionally Important Geological Sites) and other geological conservation resources of a local nature.

1.1.3 Mining and mineral resources include both deep and opencast coal mining, sand and gravel production, building stone and aggregate production from quarries, and the exploitation of other geological materials.

1.1.4 With regard to historical mining activities, these will not be assessed with regard to any settlement issues, but will be assessed with regard to remnant contamination (e.g. the possibility of contamination within backfilled quarries and pits).

1.1.5 Sources of information for mining, minerals and geological conservation resources are given in a technical note entitled Introduction to land quality assessment (see the SMR Addendum Annex F).

1.1.6 Groundwater (hydrogeological) resources and flooding are dealt with in a technical note entitled Groundwater assessment method (appended to the SMR addendum Annex K

# 2 Proposed methodology

## 2.1 General

2.1.1 Geological and mining/mineral resources will be assessed by considering the sensitivity or value of the resource and the magnitude of the impact on the resource from the construction and operation of the Proposed Scheme. These two issues are then combined in a matrix to provide an estimate of the significance of the effects on the resource.

2.1.2 As a guide to the significance of effects, the following definitions in Table 1 are based on those provided in the introduction to the Scope and Methodology Report (see Volume 5:Appendix CT 001-00/1).

Table 1: Significance of effects

| Term | Description |
|---|---|
| Major adverse | Considerable detrimental or negative impact (by extent, duration or magnitude) of more than local importance or in breach of recognised standards, policy or legislation. Always considered significant. |
| Moderate adverse | Limited detrimental or negative impact (by extent, duration or magnitude) which may be considered to be significant. |
| Slight adverse | Slight, very short or highly localised detrimental or negative impact without a significant consequence. |
| Negligible | Imperceptible impact to an environmental resource or receptor |
| Slight beneficial | Slight, very short or highly localised advantageous or positive impact without a significant consequence. |
| Moderate beneficial | Limited advantageous or positive impact (by extent, duration or magnitude) which may be considered to be significant |
| Major beneficial | Considerable advantageous or positive impact (by extent, duration or magnitude) of more than local importance or in breach of recognised standards, policy or legislation. Always considered significant. |

## 2.2 Geological resources

2.2.1 Sections 2.2 and 2.3 present the sensitivity/value and impact magnitude tables for geological resources and mining and mineral resources, together with the significance matrix.

Table 2: Sensitivity/value of geological resources

| Sensitivity/value | Description |
|---|---|
| Very high | Geological or geomorphological Site of Special Scientific Interest (SSSI) of international importance. |
| High | Geological or geomorphological SSSI |
| Medium | Local Geological Site (LGS) |
| Low | Other local geological conservation resource |

Table 3: Impact on geological resources

| Magnitude | Description |
|---|---|
| Major | Complete loss of resource |
| Moderate | Partial loss of feature/resource or a significant impact on its setting, and/or accessibility |
| Minor | Slight loss of feature/resource, or a slight impact on its setting and/or accessibility. |
| Negligible | No significant impact |
| Positive | Creation of a new feature/resource (e.g. a new permanently accessible geological exposure) or a new geological understanding (e.g. through ground investigation) |

Table 4: Significance of effects on geological resources

| | Sensitivity/Value | | | |
|---|---|---|---|---|
| **Magnitude** | **Very high** | **High** | **Medium** | **Low** |
| **Major** | Major adverse | Major adverse | Moderate adverse | Minor adverse |
| **Moderate** | Moderate adverse | Moderate adverse | Minor adverse | Minor adverse |
| **Minor** | Minor adverse | Minor adverse | Negligible | Negligible |
| Negligible | Negligible | Negligible | Negligible | Negligible |
| Positive | Moderate benefit | Moderate benefit | Slight benefit | Negligible |

## 2.3 Mining and mineral resources

2.3.1 Sections 2.2 and 2.3 present the sensitivity/value and impact magnitude tables for geological resources and mining and mineral resources, together with the significance matrix.

Table 5: Sensitivity/value of current mining or mineral resources

| Sensitivity/value | Description |
|---|---|
| Very high | Mining or mineral resource of national importance (strategic) currently being worked. |
| High | Non-strategic mining or mineral resource currently being worked, or Specific Sites/Preferred Area for mining mineral works within a Mineral Planning Authority's (MPA) Local Plan |
| Medium | Mineral Safeguarding Areas within a MPA Local Plan |
| Low | Mineral Consultation Areas within a MPA Local Plan |

Table 6: Impact on current mining or mineral resources

| Magnitude | Description |
|---|---|
| Major | Complete loss of resource |
| Moderate | Major loss of resource or significant severance of a resource |
| Minor | Minor loss of resource with no severance |
| Negligible | No significant impact |
| Positive | Project allows definition/exploration/sustainable working of resource, thereby reducing impact (e.g. traffic) |

Table 7: Significance of effects on mining or mineral resources

| | Sensitivity/Value | | | |
|---|---|---|---|---|
| **Magnitude** | **Very High** | **High** | **Medium** | **Low** |
| **Major** | Major adverse | Moderate adverse | Moderate adverse | Minor adverse |
| **Moderate** | Moderate adverse | Moderate adverse | Minor adverse | Minor adverse |
| **Minor** | Minor adverse | Minor adverse | Negligible | Negligible |
| **Negligible** | Negligible | Negligible | Negligible | Negligible |
| **Beneficial** | Moderate | Moderate | Minor | Negligible |

# HS2 London-West Midlands

# Land quality

# Technical note – Operational issues

## A report to HS2 Ltd by Arup/URS

# Contents

# 1 Introduction

1.1.1 The purpose of this technical note is to set out the scope of the land quality assessment for the operational phase of the Proposed Scheme.

1.1.2 There are several strands to the land quality assessment of operational issues:

- contamination at depots;
- contamination from other buildings/areas (e.g. stations, auto-transformer sites);
- contamination on track areas;
- contamination from the operation of high speed trains on the tracks; and
- Continued sterilisation of minerals located within influencing distance of the railway.

1.1.3 These issues will be addressed in turn in this technical note.

1.1.4 The methodology of assessment of existing contamination on depot sites, railway stations and the track area is covered within a separate technical note 'Detailed methodology for land contamination assessments' (appended to the SMR addendum Annex F).

# 2 Operational issues

## 2.1 Depot areas

2.1.1 There are two proposed depot areas:

- the Infrastructure Maintenance Depot (IMD) at Calvert in Buckinghamshire; and
- the proposed depot at Washwood Heath in Birmingham.
- Both will cover significant areas of land (the Washwood Heath depot is approximately 1.6km long by 400m wide and the IMD covers approximately 37ha). At present the Calvert area comprises mainly agricultural land whereas Washwood Heath is a former rail depot and partially developed brownfield land with adjacent residential areas.

2.1.2 The IMD will house all the plant and materials that are required to maintain the track. The site will contain the following main elements:

- workshops;
- maintenance sheds;
- six stabling sidings;
- administration offices; and
- Parking areas and balancing ponds.

2.1.3 As such the IMD site will store, handle and use a variety of potentially contaminative materials which will be used in these operations. Such materials will potentially include:

- clean and used ballast and sub-ballast materials;
- waste storage;
- fuel oils;
- cleaning fluids;
- lubricating and hydraulic oils;
- solvents and degreasers;
- herbicide/pesticide storage; and
- miscellaneous construction materials.

2.1.4 The proposed Washwood Heath depot will be responsible for all maintenance of rolling stock to be used on the route. As such the facilities will contain the following:

- a workshop/maintenance shed;
- carriage cleaning facilities;
- a wheel lathe and plant room;
- a controlled emissions toilet facility;
- rolling stock battery servicing facilities;
- overhead cranes;
- fluid and hazmat storage;
- a water and wash fluid replenishment facility;
- network control centre and administration offices
- water discharge; and
- stabling roads.

2.1.5 The types of contaminative materials that are likely to be present on the Washwood Heath depot site will include:

- fuel oils;
- cleaning fluids;
- metals;
- paints;
- lubricating and hydraulic oils;
- solvents and degreasers; and

- sewage.

2.1.6 Because of their proposed use, an assessment will be undertaken within the land quality section, of their potential for contaminative releases. The operation of the sites will be governed by environmental regulations and good practice, however the assessment will note any particular safeguards (mitigation measures) that may also be required.

## 2.2 Stations and other buildings/areas

2.2.1 There will also be a number of other buildings or areas which could lead to contamination. These include:

- the stations (Euston, Old Oak Common, Birmingham Interchange, Curzon Street); and
- auto-transformer stations.

2.2.2 The stations will generally give rise to a much smaller range of contaminative materials than depots. Given modern design standards the likelihood of significant contamination from the operation of stations is not considered significant, and can therefore be scoped out of the assessment.

2.2.3 The only contamination risk with transformer station sites is the small potential for ground contamination from accidental spillage of coolants. Where necessary, the transformers will incorporate secondary containment appropriate to the level of risk and to minimise external leakage/spillage. Therefore it is considered that the risk of significant contamination of ground or groundwater in the vicinity of auto transformer stations is very low and can therefore be scoped out of the assessment.

## 2.3 Track and trackside area maintenance

2.3.1 Contamination from the maintenance of track and trackside areas will be limited. Track switch locations will require maintenance and lubrication. The quantities of lubricants required are low, and the lubricants themselves are water repellent and can be bio-degradable, such that any effects on the underlying ground, groundwater and drainage system may be reduced. Sleepers will be concrete (not wooden) and therefore not subject to protection by wood preservatives. Vegetation maintenance will be required possibly with the use of herbicides to keep vegetation under control. There will be track side parking areas at track access locations and these may be subject to small amounts of oil contamination from fuel or oil leaks

2.3.2 Track and trackside maintenance will be subject to environmental controls and management systems. Overall, the degree of contamination from track and trackside maintenance is not expected to be significant and can therefore be scoped out of the assessment.

## 2.4 Operations

2.4.1 The operational trains are powered through overhead electric cables. The operation of the trains on the tracks will give rise to local generation of contaminants through wear and tear of contact areas causing mainly metal release. There is also the possibility of

leakage of hydraulic or lubricating oils from the gear boxes and axle boxes of trains or from points machines but this is not expected to be significant.

2.4.2 Maintenance trains will be powered by the overhead electrical system, but will also have diesel engines (for motive power whilst the overhead electrical system is switched off) and other ancillary uses.

2.4.3 There will be no release of sewage on the track from on-board toilets as these will be sealed systems.

2.4.4 The main contact issues are:

- wear of the (mainly) copper contact wire;
- wear on the pantograph contact (metallised carbon);
- brake wear (brake pads and wheel linings); and
- wheel to rail contact and abrasion.

2.4.5 Some studies have been undertaken on this issue. The most widespread study was undertaken in Switzerland on their 7,200km network. They estimated abrasion losses of operating components across the network, and presented the data both as annual losses per annum of various metals and oils, and as mass/km length of track. Of the common contaminative metals the greatest losses (and therefore the highest potential for contamination) were from copper which abrades from the contact wire, losses from which were estimated at 5,280 grams/kilometre/year. Because abrasion occurs at a high level (above the train), there is a greater propensity for copper particles to be distributed outside the railway corridor through wind dispersal, in comparison with abrasion losses at track level (e.g. from brakes). Abrasion at track level is predominantly of iron (from wheel and rail) and iron is not considered to be a contaminative material.

2.4.6 Dutch railways have also estimated copper losses from contact wire abrasion and have estimated a loss of 0.15 grams/train/kilometre. Assuming 180 trains per day, this would give a rate of loss of 9,860 grams/kilometre/year.

2.4.7 In the UK, copper losses have been estimated from typical replacement times for contact wire. The contact wire needs replacement when the abrasion losses on the underside of the wire reduce the wire diameter to two thirds of its original diameter. It is estimated that this occurs after 50 years of use. Based on a contact wire diameter of 13.2mm, this loss equates to 7,120 grams/kilometre/year.

2.4.8 The above three estimates, although not identical, are of the same order of magnitude. Differences between estimates would be expected given that there will be a number of variables which contribute to copper losses on the contact wire which may differ between countries and railway operators.

2.4.9 Based on the above figures an estimate has been made of the potential copper pollution from the operation of the Proposed Scheme. The copper particles abraded from the contact wire are very small and are likely to be spread over a considerable width both on the track and adjacent to the track. Assuming that the width of deposition is 20m either side of the track centreline and that over a period of time the additional copper becomes mixed with the topsoil to a depth of 300mm, the

additional copper load within the topsoil would be between about 0.2 and 0.4mg/kg copper/ year. This is not considered to be significant.

2.4.10 It should be noted that the figures above were generated, in the main, by low speed lines with higher levels of braking and turning which would arguably lead to greater abrasion losses.

2.4.11 It should also be noted that trackside drainage systems will be required to cope with all/any contamination in surface run-off to comply with environmental permitting regulations.

2.4.12 Taking the above into consideration, the scale of loss of copper from abrasion of the contact wire will lead only to small increases in copper concentrations in near surface topsoils adjacent to the railway. Therefore contamination from abrasion losses will be scoped out of the assessment.

# 3 Summary

3.1.1 Given the nature of the materials used and stored at the two depot sites it is considered that there is a risk of operational contamination. These sites will therefore be considered within the land quality assessment.

3.1.2 It is unlikely that stations will give rise to a risk of significant contamination and this aspect will be scoped out of the assessment.

3.1.3 There is a minimal risk of contamination from auto-transformers and therefore they will be scoped out of the Land Quality assessment.

3.1.4 It is unlikely that track and trackside maintenance will give rise to a risk of significant contamination effects and will be scoped out.

3.1.5 The biggest abrasion losses are likely to be those of copper from abrasion of the contact wire. However data from a number of railway operators indicate that the scale of loss of copper from abrasion of the contact wire would lead at most to only small increases in copper concentrations in near surface topsoils adjacent to the railway. Therefore contamination from abrasion losses will be scoped out of the assessment.

# HS2 London-West Midlands

# Land quality

# Technical note – Potential mitigation measures

## A report to HS2 Ltd by Arup/URS

# Contents



**List of tables**

# 1 Introduction

1.1.1 The purpose of this technical note is to provide guidance with regard to potential approaches that could be followed when specifying mitigation or remediation within the Land quality assessment of the ES for the Proposed Scheme.

1.1.2 This technical note discusses issues of land contamination first, followed by mitigation of effects on mining/mineral resources and geo-conservation resources. The note supports the general principle that, in the case of the expected forms of contamination (wherever it is found in the Proposed Scheme and when it has been fully defined), this will be mostly amenable to remediation using established technologies in preference to off-site disposal. Mitigation measures for construction and operational effects should be treated separately.

1.1.3 The proposed mitigation measures that are anticipated will be described in the ES, together with the significant effects remaining after mitigation (termed the residual significant effects). Where the Proposed Scheme is likely to improve environmental conditions (over and above the baseline), these effects will be identified.

1.1.4 In the case of land contamination, the contamination in the ground is often already present. The amount of remediation required need be no more than to allow safe development of the site suitable both for its proposed use and for the wider environment. Once remediated (which may include systems of management and control) there should be no significant adverse residual impacts and there may well be a beneficial effect on the surrounding environment through the removal or immobilisation of contaminants.

# 2 Land contamination

## 2.1 Legal basis

2.1.1 With regard to contamination, HS2 Ltd may need to remediate land over which the Proposed Scheme passes, where:

- the Proposed Scheme exacerbates any existing pollutant linkage, where these linkages are not the responsibility of HS2;
- HS2 Ltd becomes the "responsible person" or owner of the pollution;
- the Proposed Scheme causes a pollutant linkage to be put in place; and/or
- the Proposed Scheme compromises permanently the ability to remediate existing contamination (within the land required temporarily or non operationally) at some later date.

2.1.2 Any remediation or other mitigation undertaken would need to be sufficient such that the land could not be identified currently as 'contaminated land' under Part IIA legislation (EPA 1990[1]).

[1] *Environmental Protection Act 1990*. London, Her Majesty's Stationery Office.

## 2.2 Guidance

2.2.1 Guidance on the management of investigation, assessment and remediation of contaminated land is contained within the Environment Agency publication CLR11 Model Procedures for the Management of Land Contamination[2]. Detailed guidance on examples of various remediation methodologies is contained within numerous publications produced by the Environment Agency, CIRIA, BRE and other organisations:

- Remedial Treatment Data Sheets[3];
- Selection of Remedial Treatments for Contaminated Land. A Guide to Good Practice[4];
- Remedial Treatment of Contaminated Land Vol I – XII[5];
- Technical Options for Managing Contaminated Land[6];
- Definition of Waste: Development Industry Code of Practice[7]; and
- Guidance on the Assessment and Monitoring of Natural Attenuation of Contaminants in Groundwater[8]. Remedial Targets Methodology.

2.2.2 This is not an exhaustive list and there are many other documents which describe methodologies and the basis for choosing between them.

## 2.3 Development of remedial strategies

2.3.1 It is assumed that prior to a remedial strategy being formulated, sufficient investigation, monitoring and risk assessment will be undertaken in order to identify the nature and extent of contamination that needs to be remediated. The remedial strategy chosen will then address the risks to all receptors affected.

2.3.2 Contamination remediation methodologies for soil will be chosen following the hierarchy given below:

- reuse of un-remediated material in a location where it does not constitute a risk;
- on-site treatment and subsequent reuse on site;
- nearby off-site treatment and re-importation to site and reuse (e.g. use of a hub and cluster approach using a soil treatment centre);
- off-site treatment and reuse on other projects; and
- off-site disposal (with or without treatment).

2.3.3 The last option may be appropriate for materials that cannot be suitably treated (e.g. asbestos, recent domestic waste) or for material for which there is no suitable use

[2] Environment Agency (2004), *CLR11 Model Procedures for the Management of Land Contamination.*
[3] Environment Agency *Remedial Treatment Data Sheets.*
[4] CIRIA (2004), *Selection of Remedial Treatments for Contaminated Land. A Guide to Good Practice.*
[5] CIRIA (2005), *Remedial Treatment of Contaminated Land Vol I – XII.*
[6] Safegrounds/CIRIA (2004), *Technical Options for Managing Contaminated Land.*
[7] Contaminated Land: Applications in Real Environments (CL:AIRE) (2011), *Definition of Waste: Development Industry Code of Practice.*
[8] Environment Agency (2000), *Guidance on the assessment and monitoring of natural attenuation of contaminants in groundwater.*

(even after treatment) in the vicinity of its source area (i.e. it is not economically feasible to treat).

2.3.4 The choice of contamination remediation methodologies for groundwater will depend on a number of factors including:

- the nature of the contaminants and their variability within a plume;
- the nature of the aquifer;
- access to all relevant areas at the ground surface;
- the time allowed for remediation (which may include monitored natural attenuation (MNA), see Paragraph 2.4.9); and
- the target criteria to be used.

2.3.5 The choice of remediation methodologies for ground gasses may include any or a combination of the following:

- vertical or horizontal gas cut-offs;
- gas membranes within building floor slabs;
- active or passive gas venting; and
- monitoring systems.

2.3.6 Sustainability factors will be taken into account in the choice of methodology. Guidance on sustainable remediation is obtainable from Sustainable Remediation Forum (SURF), a non-profit corporation which aims to develop and disseminate best practice in sustainable remediation.

2.3.7 It is envisaged that there will be no requirement for land contamination mitigation during the operational stage. However, it is likely that where mitigation works have been carried out during the construction stage, there may be a requirement for on-going monitoring (e.g. of groundwater and/or gas) extending into the operational stage.

2.3.8 A number of treatment technologies may be used at any one site in order to treat one or more contaminants in one or more media (e.g. in soils and in groundwater).

## 2.4 Remedial methodologies

2.4.1 There are a wide variety of potential treatment methodologies; those that are most likely to be used for the Proposed Scheme are given in this section 2.4. This is not an exhaustive list, and other technologies may be considered where appropriate.

### Soil remediation technologies

#### *Reuse*

2.4.2 Contaminated soils may be reused, whether treated or not, as long as a risk assessment shows that they are suitable for use in the area in which they are to be

used. Rules governing the reuse of soils are contained within the 'The Definition of Waste; Development Industry Code of Practice'[9].

### *Bio-remediation*

2.4.3 Excavation and placing of contaminated soils in bio-piles or windrows, followed by aeration, and where required, addition of composting materials, nutrients and microbial inocula. This technique is useful for remediation of hydrocarbon contamination. Treatability studies are generally required and remediated soil can be usually reused on site following treatment.

### *Soil stabilisation*

2.4.4 Excavation and batch treatment of soil with additives such as lime, cement and other proprietary materials to alter the physico-chemical characteristics of the soil, to reduce the leachability of contaminants within the soil and/or reduce the permeability of the soil. Useful for a wide range of contaminants, both organic and inorganic. Significant areas required for stockpiling of untreated and treated soils. Treatability studies are generally required and remediated soil can be reused on site following treatment. Stabilisation may be required independently for geotechnical purposes.

### *Soil washing*

2.4.5 Excavation and batch or continuous treatment of soils to remove contaminants (or the soil matrix that contains the contaminants). In practice the finer particles (clays and silts) with contaminants adhered to them are separated from the coarser particles (sands and gravels) which can then be reused. Wash water can be recycled, but contaminated residues may need to be disposed of at a landfill site. It can be used on soils with a wide range of contaminants, but the soils themselves need to have a reasonably high proportion of re-usable granular materials (>70%) for the process to be economic.

### *Thermal desorption*

2.4.6 Contaminated soils are heated up to increase the volatility of contaminants such that they can be removed from the solid residues and collected/treated. It is generally used for complex organic compounds (such as pesticides) which are not amenable to bio-remediation.

### *Cover systems and vertical cut-offs*

2.4.7 Contaminated soils are left in the ground and the pollutant linkage broken by placing a cover system on top of the contaminated soil and/or providing a cut-off around the contaminated soil. Cover systems most often comprise clay systems sometimes accompanied by geotextiles, capillary break systems etc. Alternative geo-synthetic clay systems are also used. Vertical cut-offs comprise bentonite, concrete or sheet steel barriers. No remediation trials are generally necessary and they can be installed quickly if required. However, contaminants are not removed or destroyed.

[9] CL:AIRE (2011), *The Definition of Waste: Development Industry Code of Practice Version 2.*

### *Off-site disposal*

2.4.8 Some contaminated materials are not amenable to treatment and reuse, and will need to be disposed of off-site in appropriately licensed landfill sites. Such materials may include asbestos containing materials (ACM) and recent domestic waste.

## Groundwater remediation technologies

### *Monitored natural attenuation (MNA)*

2.4.9 MNA consists of the monitoring of groundwater to confirm whether natural attenuation processes (physical, chemical and biological) are acting at a sufficient rate to ensure that the wider environment (external to the immediate area of the contamination plume) is essentially unaffected (i.e. within agreed remedial targets) such that remedial objectives will be achieved within a reasonable timescale, typically less than 30 years.

### *Impermeable and permeable reactive barriers*

2.4.10 Installation of a (generally) vertical barrier system to either control groundwater flow or to channel contaminated groundwater (a contaminant plume) through one or more permeable parts of the wall where contaminants will be removed or deactivated by chemical and/or biological means, by constituents of the wall (such as zero valent iron).

### *In situ groundwater remediation*

2.4.11 Groundwater may be treated in situ by a number of different methods which may be used in combination. Typically such methods will involve one or more of the following:

- soil flushing (to remove hydrocarbon contaminants from the unsaturated zone);
- vacuum extraction of vapours in the unsaturated zone;
- removal of floating product (non aqueous phase liquids - NAPL) by pumping, vacuum extraction etc.;
- introduction of compressed air into the groundwater to volatilize dissolved organics (air-sparging), followed by vacuum extraction;
- introduction of reducing and/or oxidising chemicals into the water to promote breakdown of hydrocarbon contamination (e.g. reductive dechlorinisation); and
- introduction of additional microbes into the unsaturated zone or groundwater to promote breakdown of hydrocarbon contamination.

### *Pump and treat*

2.4.12 Pumping and removal of contaminated groundwater from the ground, ex situ treatment (e.g. air-stripping, carbon adsorption) and re-injection of the treated water. The distribution of the pumping and re-injection wells can be used to create a hydraulic control of the aquifer to prevent further migration of the contaminated groundwater.

### Ground gas remediation

#### *Ground gas cut-offs*

2.4.13 Cut-offs to prevent ground gas migration may be either vertical or horizontal and typically comprise an impermeable membrane (such as HDPE) through which the gasses cannot penetrate. The biggest issue in using such systems is ensuring that during placement (and subsequently) the membrane is not damaged or torn, such as to allow migration pathway. Cut-offs are often used in conjunction with venting layers.

#### *Ground gas venting*

2.4.14 Ground gas venting controls the migration of ground gasses such that they can vent to atmosphere in a location which does not cause any significant risks. Venting materials includes natural soils (gravel, aggregates) and man-made materials (such as polystyrene vent formers). Often used in conjunction with cut-offs.

#### *Removal*

2.4.15 Gas generating material (such as domestic waste, peats) may be excavated and removed. This is often undertaken when the gas generating material also causes other problems such as intolerable settlement.

#### *Monitoring*

2.4.16 Gas monitoring may be used when gas concentrations are generally low enough not to cause an issue, but occasional high concentrations may occur. The monitoring needs to be linked to a management plan. Within buildings, such systems monitor gasses on a semi-continuous basis and can sound alarms when concentrations rise above pre-set criteria.

# 3 Mining and minerals

3.1.1 Mitigation of mining and mineral affects will depend on the type of impacts suffered by the mining or mineral resource:

- complete or partial sterilisation of the resource;
- severance[10] of the resource; and
- constraint on use of the resource (e.g. cutting an access road).

3.1.2 The mitigation measures to be considered are therefore likely to include:

- use of the resource prior to or during construction of the Proposed Scheme (e.g. use of sands and gravels within the Proposed Scheme by excavating and stockpiling the resource for later use). Over-excavation may be required in order to remove all the usable resource, followed by infilling with suitable materials);
- provision of additional access to a site (in the case of severance); and

[10] In this context, severance refers to the Proposed Scheme splitting an actual or proposed mining/mineral site into two or more areas, such that separate accesses would be required to work the whole site.

- provision of alternative access to a site.

# 4 Geo-conservation

4.1.1 Mitigation of geo-conservation effects will depend on the type of impacts suffered by the geo-conservation resource:

- complete or partial loss of the resource;
- severance of the resource; and
- constraint on access to the resource (e.g. cutting an access road).

4.1.2 The mitigation measures to be considered are therefore likely to include:

- partial or full replacement of a geological resource at the same stratigraphical horizon but in a geographically different area (could be either adjacent to the scheme or remote from it);
- if an alternative location cannot be found then intensive investigation and recording of the site before it is constructed upon, including removal of rock and fossil specimens; and
- providing alternative or additional access to sites where the access or the site has been severed.

# 5 Mitigation interactions

5.1.1 An important aspect of the identification of mitigation measures is that there is appropriate consideration of the effects that mitigation measures may have on the environment.

5.1.2 Table 1 presents some of these potential effects, taking examples from the mitigation measures described above.

Table 1: Examples of other effects arising from mitigation measures

| **Mitigation/remediation method** | **Effects** |
|---|---|
| Bio-remediation, soil washing, soil stabilisation | Typically these require large areas for stockpiling and equipment, which may require additional temporary land –use and effects on ecology, agricultural land, landscape etc. |
| Off-site disposal | Will increase total required amount of soil to be landfilled (to be taken into account in waste topic) and traffic impacts/air quality impacts |
| All groundwater methods | Effects on groundwater, such as changes to levels and yields at springs or wells. |
| Replacement of geological resources | Will require additional land and therefore may have effects on ecology, agriculture, landscape |

# Annex G: Landscape and visual assessment – technical notes

1.1.1 The following technical notes are appended to this document:

- Approach to tranquillity assessment
- Zone of theoretical visibility production methodology
- Approach to verifiable photomontages

# HS2 London-West Midlands

# Landscape and visual assessment

# Technical note – Approach to tranquillity assessment

## A report to HS2 Ltd by Arup/URS

# Contents



**List of tables**

# 1 Introduction

1.1.1 This note has been prepared to provide further detail on how the tranquillity of landscape character areas has been determined through applying the general methodology set out in the landscape and visual sections 12.2.12 and 12.2.13.of the Scope and Methodology Report (SMR) (Volume 5; Appendix CT -001-000/1)

1.1.2 In the context of the landscape assessment, tranquillity is defined by the interrelationship of the criteria provided in section 2.1.2. Defining tranquillity enables a determination of the sensitivity of a character area, alongside consideration of character, condition and value (as described in the SMR).

1.1.3 While the criteria that influence tranquillity remain constant, they are considered differently for urban and rural scenarios. In rural locations, the absence of visually detracting features, built form and noise from man-made sources may be associated with valued areas of high tranquillity. In urban areas, enclosure and vegetation may be associated with valued areas of high tranquillity, despite the presence of built form and sources of noise.

1.1.4 The parameters which have influences on how the level of tranquillity has been determined are provided below for urban areas (Section 2) and rural areas (Section 3).

# 2 Determining tranquillity in urban areas

2.1.1 In urban areas, the qualities that people value by virtue of the seclusion offered from surrounding development, infrastructure and activity have been identified. Areas that display these qualities may therefore be considered to have a high level of tranquillity, which may in turn contribute to a character area which is highly sensitive to change.

2.1.2 As set out in the SMR, the criteria that influence tranquillity are:

- land use;
- level of seclusion or isolation, including perception of nature;
- extent and type of enclosure by surrounding land uses;
- level of screening afforded by vegetation, ground level change or boundary treatments;
- levels and types of vehicular traffic and noise within, or close to the character area;
- levels of pedestrian traffic and noise within, or close to the character area;
- level of light pollution; and
- the absence or presence of major infrastructure routes within or in the vicinity of the character area.

2.1.3 Further detail on how these criteria have been applied in an urban environment is provided in Table 1. The presence of any combination of criteria may be considered when assessing the tranquillity of a character area.

Table 1: Determining tranquillity in urban areas

| Criteria | Level of tranquillity | | |
|---|---|---|---|
| | **High** | **Medium** | **Low** |
| Land use | Open space or an area that is characterised by low density residential development set amongst large/frequent open spaces. | Medium density residential land uses with some open spaces. | High density residential land uses.<br>Industrial/ commercial uses.<br>Leisure uses.<br>Widespread presence of hard standing. |
| Seclusion/isolation (also associated with levels of pedestrian traffic) | Quiet green locations with a noticeable presence of nature.<br>Infrequent use by local communities.<br>Areas dominated by substantial water bodies absent of leisure uses. | Areas principally used by local communities (local parks, residential communities).<br>Discernible presence of nature. | Areas with a high frequency of use by people – city/town centres, retail areas, places of employment, leisure uses.<br>Often associated with relatively high levels of sound from activity. |
| Enclosure / Screening | Strong enclosure from surrounding development by dense vegetation/ substantial avenues of street trees/dense vegetation within private gardens.<br>No/few overlooking buildings. | Localised enclosure provided by residential buildings (for example residential suburbs).<br>Presence of street trees and vegetation within front/rear gardens. | Dense development with numerous overlooking buildings.<br>Open vistas across urban areas.<br>No/few street trees/private gardens/front gardens in residential areas. |
| Vehicular traffic | Very limited levels – no overly noticeable presence of vehicles or the sound of vehicles. | Relatively light levels of traffic and traffic noise associated with the local residential area only (i.e. no/few through routes/main roads. No or very limited HGV traffic. Some on-street parking associated with local residential use only. | Presence of busy routes (rail or road) forming a key part of the character area or boundaries of the character area.<br>Presence of HGV traffic.<br>Presence of substantial levels of parking.<br>High levels of noise from traffic. |
| Light pollution | Largely unlit.<br>Potentially some residential areas with very low levels of street lighting. | Residential street lighting and low levels of light spill from low/medium density residential development. | Substantial levels of public realm lighting/street lighting/light spill from large commercial/retail/ civic buildings. Substantial lighting of industrial compounds/hard standings/car parking. |
| Major infrastructure routes | Absence of noticeable major infrastructure (road, rail, utility) or noise from major routes within the character area or within the immediate setting of the character area. | Absence of noticeable major infrastructure road/rail/utility routes or noise from major routes within the character area. Some presence of electricity pylons/A roads/relatively infrequently used railway lines within parts of the wider setting. | Noticeable presence of major routes within the character area, including heavily trafficked roads, railway lines and electricity pylons.<br>Noticeable presence of major routes and/or noise from major routes as a substantial part of the immediate setting of the area. |

2.1.4 In an urban environment, any combination of the criteria described in Table 1 may be used to determine the tranquillity of a landscape character area. Each character area must be analysed in turn, with the key criteria identified. The key characteristics of the

area, in line with the criteria above, will be the primary influence on the level of tranquillity – for example:

- an industrial area is likely to have a **low** level of tranquillity despite the possible presence of lots of trees, little lighting and no noticeable major infrastructure routes;
- a low density residential area in very close proximity to a poorly screened (noise and/or visual) motorway/busy road or busy railway is likely to have a **low** level of tranquillity despite limited light pollution, an abundance of street trees/gardens etc.;
- a park or open space with an abundance of dense mature boundary trees and vegetation may have a **medium** or even **low** level of tranquillity if totally surrounded by dense commercial/retail/industrial land uses and/or noticeable major infrastructure routes;

2.1.5 Therefore, in line with the examples provided above, any one criterion within the **low** column of Table 1, may be considered sufficient to describe a character area as having a **low** level of tranquillity if dominant enough. If these factors do not overly dominate, then it may be more appropriate to consider a medium level of tranquillity for the area, should it fall into some of the criteria described in the medium column of Table 1.

2.1.6 In order for a character area to be considered to have a **high** level of tranquillity, it is likely that it will need to display most or all of the criteria described in the **high** column of Table 1.

# 3 Determining tranquillity in rural areas

3.1.1 In rural areas, initial reference has been made to the Tranquil Areas Maps UK[1] and the 2007 Intrusion Map[2] undertaken by the Campaign to Protect Rural England (CPRE). However, a clear judgement has been reached on the level of tranquillity for each landscape character area. Therefore, the work of CPRE has been used (where relevant) to help inform decisions in line with Table 2.

3.1.2 As set out in the SMR, the criteria that influence tranquillity are:

- land use;
- level of seclusion or isolation, including perception of nature;
- extent and type of enclosure by surrounding land uses;
- level of screening afforded by vegetation, ground level change or boundary treatments;
- levels and types of vehicular traffic and noise within, or close to the character area;
- levels of pedestrian traffic and noise within, or close to the character area;

[1] 2005-2006 CPRE (Campaign for the Protection of Rural England) with support from the Countryside Agency.
[2] Developing an intrusion Map of England, September 2007; CPRE and Land use Consultants.

- level of light pollution; and
- the absence or presence of major infrastructure routes within or in the vicinity of the character area.

3.1.3 Further detail on how these criteria have been applied in rural areas is provided in Table 2. The presence of any combination of criteria may be considered when assessing the tranquillity of a character area.

Table 2: Determining tranquillity in rural areas

| **Criteria** | **Level of tranquillity** | | |
|---|---|---|---|
| | **High** | **Medium** | **Low** |
| Land use | Open countryside with little or no noticeable built form.<br>Agricultural landscapes with a small field pattern. | Intense agricultural landscapes.<br>Landscapes with intermittent built form (small settlements, agricultural buildings. | Dominance of built form. |
| Seclusion / isolation (also associated with levels of pedestrian traffic) | Quiet green locations with a noticeable presence of nature.<br>Little evidence of any intense uses by people.<br>Limited sound levels from people. | Areas principally used by local communities (local parks, residential communities). Low levels of sound from people.<br>Discernible presence of nature.<br>Fairly intense presence of agricultural activities. | Areas with a high frequency of use by people – heavily used recreational spaces and urban fringes.<br>Often associated with relatively high levels of sound from activity. |
| Enclosure / Screening | Presence of woodland cover and regular hedgerows, defining small field patterns. Wooded skylines.<br>Also, wide open vistas across unspoilt countryside with no/little evidence of development/ infrastructure. | Large scale field patterns with limited presence of hedgerows.<br>Evidence of some development/ infrastructure within parts of the wider setting of the area. Presence of electricity pylons through the character area. | Open vistas with a noticeable presence of development/ infrastructure across the setting of the area. |
| Vehicular traffic | Very limited levels – no overly noticeable presence of vehicles or sound from vehicles. No major road or rail routes. | Relatively light levels of traffic and traffic noise associated with relatively minor roads/railways with substantial vegetation providing screening. Presence of some larger infrastructure routes as part of the wider setting. | Presence of busy routes (rail or road) forming a key part of the character area or boundaries of the character area.<br>Presence of HGV traffic.<br>High levels of noise from traffic. |
| Light pollution | Unlit countryside. Some sources of low level light within parts of the wider setting. | Some sources of low level light from intermittent traffic on minor roads or development/ infrastructure on the fringes of the character area or within the wider setting. | Substantial levels of light within or across the fringes/setting of the area, from development or major infrastructure routes. |
| Major infrastructure routes | Absence of noticeable major infrastructure (road, rail, utility) within the character area or within the immediate setting of the character area. | Absence of noticeable major infrastructure road/rail/utility routes within the character area. Some presence of electricity pylons / A roads / relatively infrequently used railway lines within parts of the wider setting. Presence of noise from aircraft / flight paths. | Noticeable presence of major routes within the character area, including heavily trafficked roads, railway lines and/or electricity pylons.<br>Noticeable presence of major routes as a substantial part of the immediate setting of the area. |

3.1.4 In a rural area, any combination of the criteria described above may be used to determine the tranquillity of a landscape character area. Each character area must be analysed in turn, with the key criteria identified. The key characteristics of the area, in line with the criteria above, will be the primary influence on the level of tranquillity – for example:

- an area of open countryside is likely to have a **low** level of tranquillity if there are a number of noticeable major infrastructure routes within the character area or dominating the setting, also introducing high levels of light pollution;

3.1.5 Therefore, in line with the example provided above, any one criterion within the **low** column of Table 2, may be considered sufficient to describe a character area as having a **low** level of tranquillity if sufficiently dominant. If these factors do not overly dominate, then it may be more appropriate to consider a **medium** level of tranquillity for the area, should it fall into some of the criteria described in the **medium** column of Table 2.

3.1.6 In order for a character area to be considered to have a **high** level of tranquillity, it is likely that it will need to display most or all of the criteria described in the **high** column of Table 2.

# HS2 London-West Midlands

# Landscape and visual assessment

# Technical note – Zone of theoretical visibility production methodology

## A report to HS2 Ltd by Arup/URS

# Contents

# 1 Introduction

1.1.1 This note has been prepared to describe in detail the methodology used to produce the zones of theoretical visibility (ZTV) of the Proposed Scheme.

1.1.2 The broad methodology for producing the ZTV is described in Section 12.5 of the Scope and Methodology Report (SMR) (Volume 5: Appendix CT-001-000/1). ZTVs have been produced to indicate the extent of the theoretical visibility of the Proposed Scheme during both construction and operation. The ZTVs have been produced using one model for the whole route to ensure route-wide consistency.

1.1.3 ZTVs have been prepared to show:

- the theoretical visibility of the Proposed Scheme during construction. This excludes cranes on the basis that these would indicate widespread visibility and take emphasis away from understanding the potential extent of significant effects. Cranes have been considered, where relevant, in the assessment of effects (see section 3.1.3).
- the theoretical visibility of the Proposed Scheme during 2026 .
- the theoretical visibility of the Proposed Scheme during 2041, taking into account the benefit maturing vegetation may have on restricting visibility.

1.1.4 The ZTVs are based on the Proposed Scheme used for the assessment of effects as presented in the ES.

# 2 Production of the base model

2.1.1 A base topographic model was produced using ArcGIS software. It used the highest resolution and most recently available digital terrain model[1] (DTM) data across the Proposed Scheme. Within approximately 350m either side of the centre line of the Proposed Scheme, the DTM utilised was a 25cm resolution LIDAR survey flown specifically for the Proposed Scheme. Beyond the Lidar data, in most urban areas, 1m resolution data was available and was utilised. In rural areas, typically only 5m resolution data was available. These datasets were combined together to create the base model. The base model extends 3km either side of the centre line of the Proposed Scheme. This model shows the ground topography only, excluding any vegetation, buildings or other structures.

2.1.2 Within the 700-750m corridor along the route (surveyed specifically for the Proposed Scheme), and for most urban areas within the 6km corridor as described above, digital surface model[2] (DSM) data was also available. The OS Mastermap product[3] was used to extract building heights from this DSM, which were added to the base topographic model. All available data sets relating to areas of woodland and linear belts of trees wider than 20m were used to extract tree cover heights from the same DSM, with the data also added to the base topographic model. The extent of vegetation cover used in the ZTV was verified on site and adjusted where possible. Any vegetation to be

[1] A digital terrain model represents the topography of the ground excluding any buildings, vegetation, vehicles etc.
[2] A digital surface model contains topographic information incorporating anything on the surface of the ground when the survey was undertaken (e.g. buildings, vegetation, vehicles).
[3] Ordnance Survey Mastermap 2013, 1:2,500 scale.

removed during construction of the Proposed Scheme was removed from the vegetation cover used in the ZTV.

2.1.3 There were many areas along the route where a DSM has not been recorded and therefore no data on building or tree heights was available. In these instances, building heights were extracted from the OS Mastermap product, and added to the base topographic model using an assumed height of 8m above ground. Outside of areas with a DSM, the same woodland and tree cover datasets described in Paragraph 2.1.2 were added to the base topographic model using an assumed height of 12m above ground.

2.1.4 These processes resulted in a base model incorporating accurate, surveyed information on topography, accurate surveyed information on building and tree heights in urban areas (where a DSM was available) and assumed building and tree heights outside of urban areas (where no DSM was available).

# 3 Modelling the construction phase ZTV

3.1.1 The extent of the visibility of the Proposed Scheme during construction was modelled on the basis of conservative assumptions about the height of typical construction plant operating along the length of the route, and at stations, depots, ventilation shafts, head houses, road diversions and any other known proposed works. These heights were added as a series of points into ArcGIS to enable the ZTVs to be produced using the 'Viewshed' tool[4]. For the purposes of modelling the construction phase ZTV that focuses on the likely distribution of significant effects, heights of very tall construction plant such as cranes have been excluded.

3.1.2 Elements modelled to enable production of the construction phase ZTV are detailed below:

- assumption of 5m above existing ground levels for the route above ground, whether it is at grade, on embankments or in cutting. This was selected on the basis of the possible height of typical construction plant expected to be used along the route;
- assumption of 5m above existing ground levels for the length of proposed green tunnels, selected on the basis of the possible height of typical construction plant expected to be used at these structures, excluding cranes;
- assumption of 8m above existing ground levels around the boundary of any known construction compounds, on the basis of the possible height of typical construction plant, storage, stacked welfare facilities etc. that may be present within these areas;
- assumption of 5m above existing ground levels at the location of all tunnel portals, selected on the basis of the possible height of typical construction plant expected to be used at these structures, excluding cranes;

[4] An ArcGIS tool which analyses where any given point is visible from.

- assumption of 8m above existing ground levels at the location of all ventilation shafts, selected on the basis of the possible height of typical construction plant expected to be used at these structures, excluding cranes;
- assumption of 5m above existing ground levels at the location of any road diversion works, new road bridge works or utility diversion works, on the basis of the possible height of typical construction plant required;
- assumption of 2m above the height of proposed viaducts and road bridges to take account of construction plant and scaffolding required to build the structures, excluding cranes;
- assumption of 2m above the height of proposed station buildings to take account of construction plant and scaffolding required to build the structures, excluding cranes;
- assumption of 2m above the height of any demolitions required, to take account of construction plant and any scaffolding that may be required, excluding cranes; and
- assumption of 2.4m above existing ground levels (i.e. the standard hoarding height) of the temporary extent of land required to construct the Proposed Scheme.

3.1.3 Cranes have been excluded from the construction phase ZTV on the basis that these indicate widespread visibility but rarely give rise to significant effects if they are the only elements visible. With the exclusion of cranes, the construction phase ZTV gives a better indication of the possible spread of significant effects and therefore better informs the assessment process.

# 4 Modelling the operational phase ZTV

4.1.1 The extent of the visibility of the Proposed Scheme during operation was modelled on the basis of the height of operational structures along the line of route, including stations, permanent depots, ventilation shafts, headhouses, road diversions and any other proposed works. The heights modelled take into account where the Proposed Scheme is in cutting, at grade, on embankment, on viaduct etc. These heights were added as a series of points into ArcGIS to enable the ZTV to be produced using the 'Viewshed' tool.

4.1.2 The base model produced for the construction phase ZTV was amended by:

- removing any buildings to be demolished during construction of the Proposed Scheme, to ensure they did not falsely block potential views when the operational ZTV was run; and
- adding new mitigation earthworks designed to screen the Proposed Scheme into the base model.

4.1.3 Elements modelled to enable production of the 2026 operational phase ZTV are detailed below:

- 4m above proposed track bed levels for trains;

- the designed height of all station buildings (excluding any possible over station development);
- the designed height of all tunnel portal buildings, headhouses and ventilation shafts (excluding any possible over station development);
- the designed height of all buildings located within permanent operational depots;
- the height of road diversions or new road bridges, excluding lighting etc.; and
- the height of any new fencing and noise barriers.

4.1.4 Overhead line equipment have been excluded from the operational phase ZTV on the basis that these indicate widespread visibility but rarely give rise to significant effects if they are the only elements visible. With the exclusion of overhead line equipment, the operational phase ZTV gives a better indication of the possible spread of significant effects and therefore better informs the assessment process.

4.1.5 The 2041 operational phase ZTV was produced using the same parameters as above, but proposed tree planting was incorporated into the base model at an assumed height of 7.5m, serving to reduce visibility of the Proposed Scheme in some locations.

# HS2 London-West Midlands

# Landscape and visual assessment

# Technical note – Approach to verifiable photomontages

## A report to HS2 Ltd by Arup/URS

# Contents

# 1 Introduction

1.1.1 This document has been prepared to describe the technical process undertaken to prepare verifiable photomontages in support of the landscape and visual assessment of the Proposed Scheme.

1.1.2 The methodologies described are based on current best practice and follow recommendations from The Landscape Institute's Guidelines for Landscape and Visual Impact Assessment Advice Note 01/11[1] and the London View Management Framework Supplementary Planning Guidance[2].

## 1.2 Verifiable photomontage

1.2.1 A photomontage is the superimposition of an image onto a photograph for the purposes of creating a representation of potential changes to any view.

1.2.2 "The objective of a photomontage is to simulate the likely visual changes that would result from a proposed development, and to produce printed images of a size and resolution sufficient to match the perspective in the same view in the field."[1]

1.2.3 A verifiable photomontage is a photomontage based on a replicable, transparent and structured process, so that the accuracy of the representation can be verified by an independent party. Collaboration between all organisations and disciplines is essential throughout the whole project to ensure that the visualisation information is consistent and robust.

# 2 Selection of photomontages

## 2.1 Selection of viewpoints

2.1.1 Viewpoints form the receptors for the visual assessment within the Environmental Statement, and represent what people having a view of the Proposed Scheme may be able to see during construction or operation. The process for selecting viewpoints is described in Section 12.2 of the Scope and Methodology Report (SMR) see Volume 5:Appendix CT-001-000/1).

2.1.2 Verifiable photomontages have been prepared from a selection of these viewpoints, based on:

- viewpoints where the level of effect is difficult to ascertain without reference to a verifiable photomontage;
- viewpoints from receptors which are highly sensitive to change (the sensitivity of visual receptors is described in Section 12.2 of the SMR); and
- viewpoints where a verifiable photomontage aids the readers understanding of the appearance of the Proposed Scheme and the level of effect.

[1] The Landscape Institute (2011) *Photography and photomontage in landscape and visual impact assessment, Landscape Institute Advice Note 01/11.*
[2] Greater London Authority (2012) *London View Management Framework Supplementary Planning Guidance.*

## 2.2 Verifiable photomontage types

2.2.1 The landscape and visual assessment considers effects for a number of different scenarios through the construction and operational phases of the Proposed Scheme. Verifiable photomontages have been prepared for the following scenarios:

- construction, winter, daytime – Illustrative representations of how the site may look during the peak phase of construction taking into account:
  - demolition, tree removal and vegetation clearance required;
  - the extent of land required temporarily to build the Proposed Scheme;
  - the type of structure being built in the view;
  - the types of operations and construction plant likely to be present in order to construct the structure in the view; and
  - any measures contained within the draft Code of Construction Practice (CoCP) relevant to the particular view.
- operation, year 2026, winter, daytime – Illustrative representations of how the Proposed Scheme may look during the winter of 2026, taking into account:
  - the accurate 3D models prepared to show the geometry of elements of the Proposed Scheme, including the route, earthworks, retaining walls, proposed highways including earthworks, balancing ponds, viaducts and bridges, ventilation shafts and head houses;
  - the accurate 2D lines prepared to show the geometry of elements of the Proposed Scheme, including fences, noise barriers, planting and habitat creation areas; and
  - design principles / intent relating to the appearance of structures described above, including retaining walls, viaducts, bridges, ventilation shafts, head houses, fencing, noise barriers, planting and habitat creation areas.
- operation, 2026, summer, daytime – Illustrative representations of how the Proposed Scheme may look during the summer of 2026 taking into account the same elements as above. These have only been prepared where it was not possible to obtain a winter photograph due to limitations such as site access.
- operation, 2041, summer, daytime – Illustrative representations of how the Proposed Scheme may look in the summer of 2041 of operation, taking into account (in addition to the above) how the new planting will grow and mature.

2.2.2 Construction photomontages were only prepared for winter in line with the methodology for undertaking the visual assessment described in the SMR.

# 3 Verifiable photography and survey

## 3.1 Methodology

3.1.1 The verifiable photomontages have been based on accurately captured and surveyed verifiable photography. Winter photography was captured between December 2012

and April 2013.Summer photography was captured in September 2012 and between July and September in 2013. The horizontal field of view was determined by the extent of visibility of the Proposed Scheme from each viewpoint. All images have a vertical field of view of 38 degrees.

3.1.2 Where viewpoints were located on a solid surface (e.g. in urban areas or along surfaced roads), the photography was captured first with a marker left on the ground. These locations were then subsequently surveyed. In rural locations, the photography and surveying was undertaken simultaneously in order to avoid problems with markers in soft ground moving or being removed altogether.

## 3.2 Verifiable photography specification

3.2.1 Image resolution:

- single frame images were supplied at a minimum of 5000 pixels wide at 300dpi; and
- panoramic images were supplied at a minimum of 15,000 pixels wide at 300dpi.

3.2.2 Image quality:

- processed tagged image file formats[3] (TIFF files) containing corrections for lens distortions[4], vignetting[5] and chromatic aberrations[6];
- any necessary sharpening was applied uniformly across images; and
- all panoramic images were free from parallax errors[7].

3.2.3 Data requirements:

- Exchangeable image format[8] (EXIF) data was provided in the file properties:
  - focal length;
  - aperture, shutter speed, ISO;
  - lens and camera body; and
  - date and time.

3.2.4 Other data (marked on each file in a separate layer):

- focal length (to three decimal places where applicable);
- the lens axis;
- the details of height over survey point (between 1.55m and 1.70m high);
- field of view;

[3] A type of file particularly suited to high resolution images.
[4] Displacement or errors in the images caused by irregularities in camera lens.
[5] Reduction of an image's brightness or saturation at the periphery when compared to the centre of the image.
[6] Colour distortion in an image caused by the inability of the camera lens to bring the various colours of light to focus at a single point.
[7] Apparent change in the direction of an object caused by changes in the camera location.
[8] Data embedded within the properties of an image.

- image dimensions;
- film gate size; and
- date and time.

3.2.5 Accuracy: Generally each individual observation set-up achieved an accuracy of + or – 45mm to Ordnance Survey grid / datum.

## 3.3 Verifiable surveying specification

3.3.1 Each camera location is surveyed together with a series of clearly defined detail points within the image (e.g. corners of road markings, features on road signs, corners of building features etc.). Each image has a minimum of 10-12 clearly defined detail points taken across the width of the image and at near, mid and far distance (i.e. a balance of points across the photograph).

3.3.2 Information provided to the surveyors:

- the camera positions for each viewpoint are marked by the photographer for the surveyor to be able to locate an exact survey position and
- prints of the images are supplied in advance in order to reference the detail points taken.

3.3.3 Surveyors deliverables:

- point for the camera locations and each detail point were given a unique number that related to the viewpoint number;
- a CAD file was provided containing the detail points and camera positions as vertical lines;
- a spreadsheet of the camera locations and detail points was provided with annotated descriptions; and
- an image of the photo showing the detail points marked on was provided.

# 4 Production of 3D model

4.1.1 The 3D model of the Proposed Scheme was produced in a series of tiles along the route. All data was moved to these offsets defined by a grid to avoid accuracy problems caused in 3D Studio Max (3DS Max) when working on images at a distance from the global origin point. This process improved how 3DS Max handled the data in the later stages of modelling and ensured accuracy. The CAD drawing units were in metres.

4.1.2 The 3D model of the Proposed Scheme was created using:

- the designers 3D model of the Proposed Scheme including the centreline, rail earthworks, highway centrelines, kerblines, highway earthworks, mitigation earthworks and balancing ponds. These elements form the digital terrain model of the Proposed Scheme;

- models of all structures including viaducts, highway bridges, pedestrian bridges, tunnel portals, auto-transformer stations;
- models of all buildings including headhouses and ventilation shafts, buildings within maintenance depots and stations; and
- models of all further elements including noise fence barriers, fencing, planting, overhead line equipment, new/relocated pylons etc.

4.1.3 Models of structures and buildings were created using the designer's 3D models or 2D elevations, sections and plans depending on what was available.

4.1.4 All elements of the 3D model were resolved from all angles, for example the abutment of bridges and viaducts were modelled in full to ensure the robustness of the overall 3D model.

4.1.5 Within 3DS Max, all surfaces created as part of the 3D model were checked to ensure no co-planar faces existed anywhere in the model, with all faces appropriately sub-divided.

4.1.6 All elements within the 3DS Max model files were named appropriately. There were no generic names within the model files e.g. box, circle, cylinder etc. to ensure all objects can be selected and all users have full control of the 3DS Max scene.

4.1.7 Textures were applied at a real world scale to ensure they appeared at the correct scale for the image and 3D model.

## 4.2 Model assembly

4.2.1 A 3DS Max model file for each viewpoint was assembled before rendering. The assembled model contains the relevant Proposed Scheme digital terrain model tiles and any structures, buildings or further elements (as defined above) that can be seen in the viewpoint.

# 5 Camera matching

5.1.1 The process of camera matching creates a virtual camera in the same location and height, and pointing in the same direction as the physical camera used on site to capture the image.

5.1.2 The process involved accurately positioning the three-dimensional model of the Proposed Scheme within each existing view. This was achieved through a process of matching the surveyed points in the digitised image with those recorded by the survey team on the existing photographs. The central horizon line in each of the existing views was then calculated and imported into 3DS Max as a backdrop to the 3D model. The survey points and specifications of the lens type relating to each view were also entered into 3DS Max.

5.1.3 The survey points of the camera position and each clearly defined detail point (relating to specified objects in the view) were then highlighted on the digitised image. A further check of the accuracy of the survey points in each digitised view was carried out by overlaying the central horizon line of each view with the digitised survey points prepared in 3DS Max. This additional check ensured that the survey points

matched precisely. This process was undertaken independently by two different designers, with the results cross referenced to provide a further check on accuracy.

5.1.4 Once the process of camera matching was completed, the 3D model of the Proposed Scheme was accurately positioned within each of the views captured. This was achieved by rendering the camera matched 3D model of the Proposed Scheme within 3DS Max at the same size as the digitised existing view.

# 6 Rendering

6.1.1 Each of the views was rendered using the Vray Rendering Engine software. This utilised the physical sun and sky and compass system to provide physically accurate full global illumination in line with the light conditions present in the existing photo. The best lighting match with the existing photo was achieved by adjusting the settings of the default daylight system in the rendering engine.

6.1.2 Individual elements were rendered out using different map channels to create masks (for example mask for the digital terrain model, earthworks, overhead line equipment, fencing, shadows etc.). These masks ensured each visible element of the Proposed Scheme could be independently selected when individually placed into the Adobe Photoshop file for final production.

# 7 Post production

7.1.1 The renders of the 3D model were superimposed on the existing photos in Adobe Photoshop. The foreground of the existing photos visible in front of the Proposed Scheme were then carefully copied and masked to ensure the render of the 3D model sits accurately within the depth of the view.

7.1.2 The textured render of the 3D model was then further adjusted to match the resolution, colouring and saturation of the photograph captured to create an accurate impression of what the textures of the buildings and structures will look like. This was a qualitative exercise and required interpretation by the designer on how the structures will look. A final qualitative check of all of the verifiable photomontages was undertaken to ensure that they provided objectively accurate views of the Proposed Scheme.

# 8 Recommended viewing distances

8.1.1 It is recommended that the panoramic verified images are viewed at an optimum viewing distance in relation to the size of printed photomontage, to give a correct sense of scale.

8.1.2 In order for the viewer at the camera location to use the images, they must be printed large enough to hold at a comfortable 400-500mm viewing distance which, for the whole panorama is often impractical because of the size. The images are provided at A3 in the Environmental Statement for practicality, and do not lend themselves to direct comparison out in the field.

8.1.3 For viewing in the field, it is more practical to use a set of 40 degree sections from the panorama, printed on A3 landscape sheets (with the image filling the full height of the paper). These can then be held up at the correct distance from the eye (as noted

above) and at the height photographed from, and this would then match what is being seen in the field. It is crucial that the viewer is standing in the precise location of where the photograph was captured from.

8.1.4 If the panoramas are to be used in the field, they should be viewed by curving them either with the use of a cylindrical object or simply by hand with a radius of 450mm. With a standard vertical field of view, panoramas should be printed at the following sizes for true representation:

- 80deg – 630mm x 300mm
- 120deg – 950mm x 300mm
- 160deg – 1200mm x 300mm

# Annex H: Socio-economics – technical note

1.1.1 It should be noted that for the purpose of the technical notes, the topic areas of community and socio-economics have been combined and can be found within Annex B to the SMR Addendum.

# Annex I:Traffic and transport – technical note

1.1.1 The following technical note is appended to this document:

- Guidance on further development of significance criteria

# HS2 London-West Midlands

# Traffic and transport

# Technical note - Guidance on further development of significance criteria

## A report to HS2 Ltd by Arup/URS

# Contents

**List of tables**

# 1 Introduction and methodology

1.1.1 This technical note provides guidance on how traffic and transport effects will be determined for the Environmental Statement (ES) for the Proposed Scheme. It is based on criteria already specified in the Scope and Methodology Report (SMR – see Volume 5: Appendix CT-001-000/1 and the SMR Addendum).

1.1.1 The methodology builds on that described in the SMR and SMR Addendum and further describes the process by which the significance of traffic and transport impacts and effects will be determined and applied in the ES.

1.1.2 The assessment process includes:

- establishing a future baseline that includes traffic and transport; and
- undertaking an impact assessment to understand the ability of the receptors to adapt to future transport demands during the construction and operation of the Proposed Scheme.

## 1.2 Use of this guidance

1.2.1 Use of this guidance will require analysis of transport data, technical assessments and professional judgments to be made and assessors should use this report to provide guidance rather than as a series of strict rules. Judgements which result in an effect being assessed as more than one category higher or lower than indicated should be exceptional and any variation will need clear justification. Where specific types of information referred to in this guidance are not available, the assessments can be based on alternative datasets so long as these are judged to be robust and appropriate for the needs of the ES.

## 1.3 Prediction and evaluation of impacts and effects

1.3.1 The ES will describe the likely significant effects including the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the Proposed Scheme.

1.3.2 A distinction has been made in the assessment between impacts and effects, where:

- **Impacts** are defined as the predicted change to the baseline environment attributable to the scheme (e.g. changes in traffic levels or delays); and
- **Effects** are the consequence of impacts on environmental resources or receptors of particular value or sensitivity and, most commonly for transport, the number of people affected or the importance of a link affected.

1.3.3 The primary objective of the assessment is to identify "significant" effects. This will be achieved by firstly assessing the magnitude of an impact and then by reviewing the extent (e.g. temporal and spatial) to which it affects receptors. The process for determining whether the result is deemed to be significant is described below.

## 1.4 Impact assessment

1.4.1 Table 1 shows the impacts that will be assessed, for both the construction and operational stages of the Proposed Scheme.

Table 1: Impacts to be assessed

| **Traffic and transport impacts** |
|---|
| Public transport delay |
| Disruption at stations/interchanges |
| Traffic flows and delays to vehicle occupants |
| Parking and loading |
| Vulnerable road user delay, amenity and ambience |
| Accidents and safety |
| Severance |
| Waterways |

1.4.2 The SMR identifies significant effects on receptors in two ways, when:

- a particular threshold is passed; or
- there is a particular combination of impacts that taken together create a significant effect.

1.4.3 The scheme-related impacts on the receptors can be measured on a spatial and temporal basis, and will be numerically quantified or employ a qualitative judgement. The SMR and Local Transport Assessment modelling should be used as the prime sources of information from which to identify the traffic and transport impacts.

## 1.5 Thresholds

1.5.1 In assessing traffic and transport impacts, thresholds are needed to define the point at which such impacts become significant effects. These effects can then be classified as of minor, moderate or major significance. The level of 'graduation' employed to define significance is therefore a key consideration of how to measure each effect.

## 1.6 In-combination impacts

1.6.1 The significance of a traffic and transport effect can be considered as the combination of the magnitude of the impact and the number of people affected, the duration of the impact (temporal) or the extent of its locational effects. The number of travellers affected will be important, as may be the sensitivity and/or value of the population or receptor. These criteria and thresholds and their measurement will be defined based on professional judgement and existing industry accepted practice.

1.6.2 Further guidance on this aspect is given in the tables that follow for each criteria. In some cases a proxy measure is included that reflects the number of travellers affected.

1.6.3 The magnitude of the impact can be measured according to the typical generic definitions in Table 2 below.

Table 2: Impact magnitude criteria for traffic and transport

| Impact magnitude | Definitions |
|---|---|
| Not significant | An impact that is unlikely to measurably affect the well-being of travellers so that the existing base case remains constant |
| Minor | An impact that is likely to or may affect a low number of travellers (with the number depending on the local context) |
| Moderate | An impact that is likely to affect a moderate number of travellers (with the number depending on the local context) |
| Major | An impact that will be high, and/or very likely to affect a major number of travellers (with the number depending on the local context) |

1.6.4 It will be necessary to use qualitative (or, where possible, quantitative) categories for assessing the number of travellers affected (e.g. low, medium, or high). Further guidance on this aspect is also given in the tables that follow for each criteria.

1.6.5 Where relevant, receptors may in addition be considered valuable and/or sensitive if:

- they could be easily affected by, or are dependent on, specific current traffic and transport characteristics or flows; and/or
- they could be adversely affected if they are subject to long-term changes in the traffic and transport flows that differ from historic norms.

## 1.7 Mitigation plan

1.7.1 For in-combination effects that are classified as major significant or moderate significant, a mitigation plan should be developed that addresses the traffic and transport scenarios and potential impacts that have been identified. It is assumed that minor effects will be mitigated during the detailed design process for the Proposed Scheme.

1.7.2 For any in-combination effects which cannot be mitigated within the scheme design (i.e. a residual impact), the consequences of proceeding with the Proposed Scheme for the receptors (i.e. travellers) should be described.

# 2 Further definition of significance criteria

## 2.1 Approach to definition

2.1.1 The SMR criteria to judge significance are to be applied as:

- a binary threshold approach to significance, i.e. an effect is either significant or not significant;
- a graduated approach which defines the 'degree' of significance.

2.1.2 The key issues to resolve in further developing the definition of the SMR significance criteria are:

- How to extend the assessment of each impact to determine the degrees of significance.
- Where numerical measures can be applied.

## 2.2 Additional methodology for assessing significance

2.2.1 Set out below is the approach which should be followed to further refine the definition of the significant effects which are being assessed.

2.2.2 When using the tables throughout this document, if a value lies exactly on the boundary between two categories, the upper (i.e. most severe) category should be used to provide a 'worst case' assessment.

2.2.3 This is a two stage process as follows:

- Stage one – SMR criteria

  Utilise the existing SMR criteria to determine whether the effect is significant and therefore should be reported within the ES.

- Stage two – refinement of assessment

2.2.4 Where the effects are deemed to be significant in the Stage 1 assessment, the Stage 2 assessment will enable them to be further categorised as being of minor, moderate or major significance.

2.2.5 The Stage 2 criteria thus build on the Stage 1 assessment, and all criteria (i.e. tabulated, bulleted or in text) need to be considered and assessed.

2.2.6 An example is shown in Table 3.

Table 3: Significance of effect - criteria for traffic and transport receptors – example 1

| **Significance - impact magnitude** | | **Not Significant** | **Minor** | | **Moderate** | | **Major** |
|---|---|---|---|---|---|---|---|
| Diversion | | < 100m | 100 – 200m | | 200 – 400m | | 400m or more |
| Duration of Impact | | < 4 weeks | 4 weeks – 4 months | 4 months or more | 4 weeks – 4 months | 4 months or more | Over 4 weeks |
| Number of travellers affected | Low | Not Significant | Minor effect | Minor effect | Minor effect | Moderate effect | Moderate effect |
| | Medium | Not Significant | Minor effect | Moderate effect | Moderate effect | Major effect | Major effect |
| | High | Not Significant | Moderate effect | Moderate effect | Major effect | Major effect | Major effect |

2.2.7 An example of the application is shown in Table 4. In example (a) there is a diversion of 200-400m, with a duration in excess of 4 months and affecting a medium number of travellers. As the duration exceeds 4 months the effect is assessed as Major. If the duration had been for between 4 weeks and 4 months the effect would have been Moderate However in example (b) the distance is identified as over 400m and therefore the effect would be classed as Major regardless of duration so long as it is in excess of four weeks.

2.2.8 Many of the criteria as set out in the SMR have a temporal scope to the assessment of an impact, which is a 'fixed' criteria that should be applied in combination with all other 'variable' criteria such as changes in journey times, numbers, percentages etc.

Table 4: Significance of effect - criteria for traffic and transport receptors – example 2

| **Significance - impact magnitude** | | **Not Significant** | **Minor** | | **Moderate** | | **Major** |
|---|---|---|---|---|---|---|---|
| Diversion | | < 100m | 100 – 200m | | 200 – 400m | | 400m or more |
| Duration of Impact | | < 4 weeks | 4 weeks – 4 months | 4 months or more | 4 weeks – 4 months | 4 months or more | Over 4 weeks |
| Number of travellers affected | Low | Not Significant | Minor effect | Minor effect | Minor effect | Moderate effect | Moderate effect |
| | Medium | Not Significant | Minor effect | Moderate effect | Moderate effect | Major effect (a) | Major effect (b) |
| | High | Not Significant | Moderate effect | Moderate effect | Major effect | Major effect | Major effect |

# 3 Significance criteria for construction assessment

## 3.1 Introduction

3.1.1 The criteria outlined below will be used to assess the significance of traffic and transport impacts and effects during construction of the Proposed Scheme.

3.1.2 Any permanent effects of construction have been considered in the operations phase assessments for traffic and transport. Thus, the impact of any ongoing increases in travel demand and the wider effects of the operations phase have been considered together.

## 3.2 Public transport delay

3.2.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

### Stage 1 - SMR criteria

3.2.2 A significant impact on journeys by bus, heavy and light rail, and the London Underground caused by the Proposed Scheme will be identified from the traffic and transport assessment and the transport modelling results and is defined as any of the following where this lasts for more than four consecutive weeks in any 12 month period:

- changes of more than 10% in a majority of journey times by rail or London Underground;
- changes in journey distance by bus of more than 400m in urban areas and 1km in rural areas;
- a relevant delay, disruption or overcrowding impact affecting the public transport network over a wide area; and
- a relevant change to service frequency, capacity, loss of through connections or reduction in hours of operation.

### Stage 2 – refinement of criteria

3.2.3 The bus journey times to be considered are the typical journey times that would be expected over the additional distance introduced as a result of the intervention, rather than specifically those of individual passengers journeys.

3.2.4 The criteria shown in Tables 5 and 6 should be applied in Stage 2, with different criteria being applied in the rural and urban areas. The bus and train profiles relating to low, medium and high frequencies are intended to reflect the numbers of people using the routes.

Table 5: Criteria for Stage 2 assessment - public transport delay, rural

| **ASSESSMENT OF PUBLIC TRANSPORT DELAY DURING CONSTRUCTION - RURAL** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | | | |
| | | Not significant | Minor | | Moderate | | Major |
| Percentage change in route end-to-end journey time | | <10% | 10-20% | | 20-40% | | 40% or more |
| Distance change | | <1km | 1-2km | | 2-4km | | 4km or more |
| No. of travellers affected/duration of impact | | Significance of effect | | | | | |
| | | <4 weeks | 4 weeks-4 months | 4 months or more | 4 weeks-4 months | 4 months or more | >4 weeks |
| <3 buses or trains/hr | Low | Not significant | Minor | Minor | Minor | Moderate | Moderate |
| Between 3-6 buses or trains/hr | Medium | Not significant | Minor | Moderate | Moderate | Major | Major |
| >6 buses or trains/hr | High | Not significant | Moderate | Moderate | Major | Major | Major |

Table 6: Criteria for Stage 2 assessment - public transport delay, urban

| **ASSESSMENT OF PUBLIC TRANSPORT DELAY EFFECTS DURING CONSTRUCTION - URBAN** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | | | |
| | | Not significant | Minor | | Moderate | | Major |
| Percentage change in route end-to-end journey time | | <10% | 10-20% | | 20-40% | | 40% or more |
| Distance change | | <400m | 400-800m | | 800-1,200m | | 1,200m or more |
| No. of travellers affected/duration of impact | | Significance of effect | | | | | |
| | | <4 weeks | 4 weeks-4 months | 4 months or more | 4 weeks-4 months | 4 months or more | >4 weeks |
| <8 buses or trains/hr<br>OR less than 5,000 passengers/day | Low | Not significant | Minor | Minor | Minor | Moderate | Moderate |
| Between 8-20 buses or trains/hr<br>OR between 5,000 and 10,000 passengers/day | Medium | Not significant | Minor | Moderate | Moderate | Major | Major |
| >20 buses or trains/hr<br>OR more than 10,000 passengers/day | High | Not significant | Moderate | Moderate | Major | Major | Major |

### Guidance on terminology

3.2.5 The following guidance on terminology is highlighted:

- a relevant delay, disruption or overcrowding impact are those caused by the Proposed Scheme during the construction phase;
- the loss of a through connection or direct linkage resulting in the inability to make a direct connection, so requiring some form of interchange to be made.

## 3.3 Disruption at stations/interchanges

3.3.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

### Stage 1 - SMR Criteria

3.3.2 A significant impact on stations/interchanges is defined as a change in the vicinity that lasts for more than four consecutive weeks in any 12 month period including:

- loss of physical linkage for the next stage of the journey;
- loss of or relocation of more than 100m of bus facilities and operations (e.g. of bus stops, passenger waiting facilities, bus stands or operator facilities);
- loss of or relocation of more than 100m of taxi facilities and operations (e.g. taxi stands, passenger waiting facilities or operator facilities); and
- loss of or relocation of more than 100m of 'park-and-ride' facilities or operations (e.g. dropping off areas).

### Stage 2 – refinement of criteria

3.3.3 The criteria shown in Table 7 below should be applied in Stage 2.

Table 7: Criteria for Stage 2 assessment - disruption at stations/interchanges

| **Assessment of disruption at stations/ interchanges during construction** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | | | |
| | | Not significant | Minor | | Moderate | | Major |
| Change in distance to replacement facility | | <100m | 100-200m | | 200-400m | | 400m or more |
| No. of travellers affected/duration of impact | | Significance of effect | | | | | |
| | | <4 weeks | 4 weeks-4 months | 4 months or more | 4 weeks-4 months | 4 months or more | >4 weeks |
| See Table 8 below | Low | Not significant | Minor | Minor | Minor | Moderate | Moderate |
| See Table 8 below | Medium | Not significant | Minor | Moderate | Moderate | Major | Major |
| See Table 8 below | High | Not significant | Moderate | Moderate | Major | Major | Major |

3.3.4 In considering relocation the convenience of any alterative location should be taken account of and the distance should relate to the change in convenience.

3.3.5 An example description for disruption at stations/interchanges is set out in Table 8, this distinguishes the number of people using the station per day in rural and urban situations. The bus and train profiles relating to low, medium and high usage are again intended to reflect the numbers of people using the routes.

Table 8: Description for disruption at stations/interchanges

| | Rural | Urban |
|---|---|---|
| Low | <3 buses or trains/hr | <8 buses or trains/hr<br>OR less than 5,000 passengers/day |
| Medium | Between 3-6 buses or trains/hr | Between 8-20 buses or trains/hr<br>OR between 5,000 and 10,000 passengers/day |
| High | >6 buses or trains/hr | >20 buses or trains/hr<br>OR more than 10,000 passengers/day |

3.3.6 The loss of a through connection or physical linkage results in the inability to make a direct connection, requiring some form of interchange movement to be made. If this occurs, then a judgement should be made as to how the movement would be made and this should then be assessed using the public transport delay criteria in Tables 5 and 6.

## 3.4 Traffic flows and delays to vehicle occupants

3.4.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

### Stage 1 - SMR criteria

3.4.2 A significant increase in traffic levels and driver/vehicle passenger delay (including delays to bus and coach passengers) is defined as any one of the following:

- a 30% increase in traffic flows (i.e. HGVs or all vehicles) [1], where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas;
- a diversion for more than four consecutive weeks in any 12 month period that leads to an increase in journey length of more than 1km on a route carrying more than 100 vehicles per day, or 5km on a route carrying more than 40 vehicles per day, or 10km on any other route; and
- where a significant change in delay relating to junction congestion resulting from the construction of the Proposed Scheme is forecast in the traffic and transport assessment and the outputs from the traffic modelling. The junctions for consideration will be discussed with the local highways authority, based on the increase in the level of congestion at the relevant location. This will be measured either as the forecast ratio of flow to capacity or degree of saturation.

[1] Based on The Institute of Environmental Assessment, *Guidelines for the Environmental Assessment of Road Traffic,* 1993.

## Stage 2 – refinement of criteria

3.4.3 The above three criteria will be used to reflect the impacts that increased traffic flows will cause in terms of increased difficulty (severance) for pedestrians crossing the road, where there may be a lack of safe adequate pedestrian crossing facilities; increased journey lengths due to diversions; and increased congestion.

3.4.4 Effects that are of duration less than 4 consecutive weeks in any 12 month period will be assessed as being not significant.

3.4.5 Changes in flows will be related to the Annual Average Weekday Traffic (AAWT) flows (where AAWT flows are not available, the criteria should be applied for those periods assessed e.g. such as 12 hour, AM or PM peak hour, with the vehicle number thresholds adjusted accordingly). As well as considering overall changes in flows, congestion indicators will be measured based on the forecast ratio of flow to capacity (RFC), degree of saturation (DoS) or the practical reserve capacity (PRC).

3.4.6 The transport assessment will provide the following information on assessed capacities of a junction, as follows:

- the congestion indicator for an approach where it increases to over 85% during the construction of the Proposed Scheme and the increase is 2% or more due to the Proposed Scheme; or
- where the congestion indicator for an approach is over 85% in the baseline and during the construction of the Proposed Scheme increases by 2% or more in the construction period.

3.4.7 This process will identify those junctions affected by construction of the scheme. The criteria shown in Tables 9 to 12 should be applied in Stage 2 as appropriate. These tables relate to the changes associated with the introduction of the Proposed Scheme, over and above those without the scheme.

3.4.8 The assessment of the change in junction capacity will draw upon a range of techniques as appropriate to the location. Where a network traffic model is available this would generally be used to identify the impacts.

3.4.9 In instances where a network traffic model is not available (e.g. in rural areas), there may be a difficulty in establishing the congestion indicators for the junctions potentially impacted by the additional traffic. In these situations 'rule of thumb' assessments based on professional judgement (such as those set out in Table 11) of junction throughputs and link capacity can be used to identify potential areas of concern and where this is the case local models should be considered as necessary. Junction capacities of minor roads with other roads will not be modelled, they will be qualitatively assessed.

Table 9: Criteria for Stage 2 assessment – traffic flows and delays to vehicle occupants (traffic severance)

| **ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Severance) DURING CONSTRUCTION** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | | | |
| | | Not significant | Minor | | Moderate | | Major |
| Increase in traffic flows (HGVs or all vehicles), where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas | | <30% | 30-60% | | 60-120% | | 120% or more |
| No. of travellers affected/duration of impact | | Significance of effect | | | | | |
| | | <4 weeks | 4 weeks-4 months | 4 months or more | 4 weeks-4 months | 4 months or more | >4 weeks |
| Road can be safely and easily crossed (<250 veh/hr inc. Proposed Scheme traffic), safe crossing facilities available | Low | Not significant | Minor | Minor | Minor | Moderate | Moderate |
| Road moderately difficult to cross safely (250-750 veh/hr inc. Proposed Scheme traffic), lack of safe crossing facilities available | Medium | Not significant | Minor | Moderate | Moderate | Major | Major |
| Road difficult to cross safely, controlled crossing facility required (>750 veh/hr inc. Proposed Scheme traffic), lack of safe crossing facilities available | High | Not significant | Moderate | Moderate | Major | Major | Major |

Table 10: Criteria for Stage 2 assessment – traffic flows and delays to vehicle occupants (traffic diversions)

| **ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Diversions) DURING CONSTRUCTION** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | | | |
| | | Not significant | Minor | | Moderate | | Major |
| Diversion distance change | Roads carrying >100 veh/day | <1km | 1-2km | | 2-4km | | >4km |
| | Roads carrying >40 veh/day | <5km | 5-7.5km | | 7.5-15km | | >15km |
| | Any other route | <10km | 10-15km | | 15-20km | | >20km |
| No. of travellers diverted/duration of impact | | Significance of effect | | | | | |
| | | <4 weeks | 4 weeks-4 months | 4 months or more | 4 weeks-4 months | 4 months or more | >4 weeks |
| Between 100-1,000 veh/day | Low | Not significant | Minor | Minor | Minor | Moderate | Moderate |
| Between 1,000-10,000 veh/day | Medium | Not significant | Minor | Moderate | Moderate | Major | Major |
| >10,000 veh/day | High | Not significant | Moderate | Moderate | Major | Major | Major |

Table 11: Criteria for Stage 2 assessment – traffic flows and delays to vehicle occupants (traffic congestion), rural

| **ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Congestion) DURING CONSTRUCTION – RURAL(where modelling not available)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | | | | |
| | | Not significant | Minor | | Moderate | | Major | |
| Change in peak hour two-way traffic flow | | <5% | <100 veh/hr | | 100-250 veh/hr | | >250 veh/hr | |
| Peak hour two-way traffic flow including Proposed Scheme traffic | | <500 veh/hr | >500 veh/hr | | >500 veh/hr | | >500 veh/hr | |
| Reserve capacity (including Proposed Scheme traffic) at non-minor road junctions | | >15% | 8-15% | | 2-8% | | <2% | |
| No. of travellers affected/duration of impact | | Significance of effect | | | | | | |
| | | <4 weeks | 4 weeks – 4 months | more than 4 months | 4 weeks – 4 months | more than 4 months | 4 weeks – 4 months | more than 4 months |
| <2% change in reserve capacity | Very Low | Not significant | Not significant | Not significant | Not significant | Not significant | Not significant | Not significant |
| 2 -5 % change in reserve capacity | Low | Not significant | Minor | Minor | Minor | Minor | Minor | Moderate |
| Between 5-10% change in reserve capacity | Medium | Not significant | Minor | Minor | Minor | Moderate | Moderate | Major |
| >10% change in reserve capacity | High | Not significant | Minor | Minor | Moderate | Major | Moderate | Major |

Table 12: Criteria for Stage 2 assessment – traffic flows and delays to vehicle occupants (traffic congestion), urban

| **ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Congestion) DURING CONSTRUCTION - URBAN** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | | | | |
| | | Not significant | Minor | | Moderate | | Major | |
| Future with-scheme Congestion Indicator | | <87% | 87 - 92% | | 92 - 98% | | 98% or more | |
| No. of travellers affected/duration of impact | | Significance of effect | | | | | | |
| | | <4 weeks | 4 weeks – 4 months | more than 4 months | 4 weeks – 4 months | more than 4 months | 4 weeks – 4 months | more than 4 months |
| <2% change in congestion indicator | Very Low | Not significant | Not Significant | Not Significant | Not Significant | Not Significant | Not Significant | Not Significant |
| 2-5% change in congestion indicator | Low | Not significant | Minor | Minor | Minor | Minor | Minor | Moderate |
| Between 5-10% change in congestion indicator | Medium | Not significant | Minor | Minor | Minor | Moderate | Moderate | Major |
| >10% change in congestion indicator | High | Not significant | Minor | Minor | Moderate | Major | Moderate | Major |

## 3.5 Parking and loading

3.5.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

### Stage 1 - SMR criteria

3.5.2 The SMR defines the significance criteria as set out below:

3.5.3 A significant impact arising from the Proposed Scheme on parking and loading, where facilities are identified to be heavily used, is defined as a change for more than four consecutive weeks in any 12 month period of:

- a predicted increase of 10 or more, or 10%, whichever is the greater, in on-street parking demand in the vicinity of a station or interchange;
- a loss of any designated on-street or off-street spaces, including spaces for disabled persons, buses, taxis, doctors, ambulances, police vehicles and car club bays;
- a loss of ten or more, or 10%, whichever is the greater, private off-street car parking spaces;
- a loss of ten or more, or 10%, whichever is the greater, off-street station car parking spaces;

- a loss of ten or more, or 10%, whichever is the greater, pedal or motorcycle parking spaces; and
- a loss of 10% or more designated loading bay spaces or facilities.

3.5.4 Any loss of parking should, where relevant, be judged against both the absolute and the percentage change and whichever calculation results in the greater number of spaces takes precedence. As an example, with a 50 space car park the absolute trigger would be a loss of 10 spaces while the 10% reduction would be five. The significance criteria would be met only with a 10 space reduction. Conversely, with a 1,000 space car park, a 10% reduction would be 100 spaces and it is this level of reduction that would be required to create a significant effect.

### Stage 2 – refinement of criteria

3.5.5 The criteria shown in Table 13 should be applied in Stage 2.

Table 13: Criteria for Stage 2 assessment – parking and loading

| ASSESSMENT OF PARKING AND LOADING DURING CONSTRUCTION | | | | | | | |
|---|---|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | | | |
| | | Not significant | Minor | | Moderate | | Major |
| Change in parking demand (number or %) | | <10 | 10-20 | | 20-40 | | >40 |
| Change in number of designated parking spaces | | 0 | 1 | | 2-4 | | 4 or more |
| Change in availability of cycle or motorcycle spaces (number or %) | | <10 | 10-20 | | 20-40 | | >40 |
| Proximity of alternative parking spaces/duration of impact | | Significance of effect | | | | | |
| | | <4 weeks | 4 weeks-4 months | 4 months or more | 4 weeks-4 months | 4 months or more | >4 weeks |
| <100m | Low | Not significant | Minor | Minor | Minor | Moderate | Moderate |
| Between 100-250m | Medium | Not significant | Minor | Moderate | Moderate | Major | Major |
| >250m | High | Not significant | Moderate | Moderate | Major | Major | Major |

### Guidance on terminology

3.5.6 The following guidance on terminology is highlighted:

- Heavily used – does a loss of spaces cause a deficit that cannot be accommodated.
- Loss of designated spaces – where possible these should be replaced and if necessary reallocated from other nearby provision.

## 3.6 Vulnerable road user delay, amenity and ambience

3.6.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

3.6.2 The terminology of vulnerable road user within this section relates to all pedestrian, cyclists and equestrians and should not be considered to relate solely to those with mobility impairment.

## Stage 1 - SMR criteria

3.6.3 Where there are changes to routes used by vulnerable road users, impacts of delays to pedestrians, cyclists, equestrians and others will be assessed based on changes in the 'person-minutes' of the journey times of pedestrians and other non-motorised travellers (based on Department for Transport WebTag Unit 3.5.5)[2]. The following information will be addressed:

- numbers of pedestrians, cyclists equestrians and others; and
- changes in journey time in minutes arising from the delays.

3.6.4 Additional delays and changes in ambience will be defined in proportion to the scale of the impacts being assessed, for example as minor (less than one minute), moderate (between one and two minutes) and major (greater than three minutes); and the numbers of travellers affected per day as: minor (less than 200 in total), moderate (between 200 and 1000) and major (greater than 1000).

3.6.5 The significance of the impacts of changes in journey time is based on the matrix shown in Table 14, which has been taken from the SMR Addendum.

Table 14: Significance levels for travellers affected by delay during construction

| | **Journey time changes** | | |
|---|---|---|---|
| Number of travellers affected | Minor | Moderate | Major |
| Minor | Neutral | Neutral | Minor |
| Moderate | Neutral | Minor | Moderate |
| Major | Minor | Moderate | Major |

Source: SMR Addendum

3.6.6 WebTAG Unit 3.3.13 the Journey Ambience Sub-objective, describes the assessment of ambience, which includes travellers amenity. Travellers journey ambience can be affected by:

- traveller care;
- travellers' views; and
- traveller stress.

3.6.7 Traveller care for pedestrians, cyclists, equestrians and others will be assessed through the provision and design of dedicated facilities (e.g. footpaths, cycle lanes and crossings, information), as well as their cleanliness and environment.

3.6.8 The extent to which travellers can see the landscape or townscape view will vary with the relative height of the Proposed Scheme and the surrounding ground, vegetation, buildings and structures. Views can be categorised as providing:

- no view - where the route is in a deep cutting, a tunnel or surrounded by environmental barriers;
- restricted view - where there are frequent cuttings, tunnels or barriers;
- intermittent view - where there are shallow cuttings or barriers; and

[2] Department for Transport , WebTAG; www.dft.gov.uk/webtag/index.php; Accessed 08 July 2013.

- open view - where the view extends over many miles.

3.6.9 Traveller stress is the adverse mental and physiological effects experienced by travellers. Three main factors influence traveller stress:

- frustration;
- fear of potential accidents; and
- route uncertainty.

3.6.10 Taken together, these can lead to feelings of discomfort, annoyance, frustration or fear culminating in physical and emotional tension that detracts from the quality and safety of a journey.

3.6.11 Assessments will be made of the traveller care, travellers' views and traveller stress ambience factors in relation to the topics in Table 15. These assessments will consider changes due to the impact of the Proposed Scheme on each of these sub-factors as relevant using a simple three point scale (i.e. better, neutral or worse than existing ambience).

Table 15: Environment - Journey Ambience

| Factor | Sub-factor | Better | Neutral | Worse |
|---|---|---|---|---|
| Traveller care | Cleanliness | | | |
| | Facilities | | | |
| | Information | | | |
| | Environment | | | |
| Travellers' views | - | | | |
| Traveller stress | Frustration | | | |
| | Fear of potential accidents | | | |
| | Route uncertainty | | | |

3.6.12 An overall impact score for the quality of a journey will be determined using the following guidelines:

- the overall assessment is likely to be neutral if the assessment is neutral for all or most of the sub-factors, or improvements on some sub-factors are generally balanced by deterioration on others;
- if the change in impact across the sub-factors is, on balance, for the better, the assessment is likely to be beneficial, and, conversely, it is likely to be adverse if there is an overall change for the worse;
- the overall assessment is likely to be minor (beneficial or adverse) where the numbers of travellers affected is low (less than 200 a day);
- the overall assessment is likely to be major (beneficial or adverse) where the numbers of travellers affected is high (more than 1,000 per day); and
- the overall assessment is likely to be moderate (beneficial or adverse) in all other cases.

3.6.13 The methodology set out above will be applied to the Proposed Scheme on a locational basis where ambience issues for pedestrian, cyclists, equestrians and others are considered likely to be of concern. In addition, it is likely that more general conclusions in relation to more aggregated areas will also be reached.

### Stage 2 – refinement of criteria

3.6.14 Where there are impacts in delays to pedestrians, cyclists, equestrians and other vulnerable road users they will be assessed based on changes in the 'person-minutes' of the journey times of pedestrians and other non-motorised travellers.

3.6.15 To avoid double counting, increased journey times arising from, for example, diversion of footpaths or cycle routes, should be reported only once and this will be undertaken against the severance topic discussed in Section 3.8. Against this topic, changes in journey time due to delays arising from, for example, increased crowding and congestion or new signal controls should be reported.

3.6.16 Effects that are of duration less than 4 consecutive weeks in any 12 month period will be assessed as being not significant.

3.6.17 The thresholds specified in paragraph 3.6.4 of the SMR addendum have been amended to read as follows: additional delays and changes in ambience will be defined in proportion to the scale of the impacts being assessed, for example as not significant (less than 1 minute), minor (between one and two minutes), moderate (between two and three minutes) and major (greater than three minutes); and the numbers of travellers affected per day as: low (less than 200 in total), medium (between 200 and 1000) and high (greater than 1000).

3.6.18 The criteria shown in Table 16 should be applied in Stage 2.

Table 16: Criteria for Stage 2 assessment – vulnerable road user delay, amenity and ambience

| **ASSESSMENT OF VULNERABLE ROAD USER DELAY, AMENITY AND AMBIENCE EFFECT DURING CONSTRUCTION** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | | | |
| | | Not significant | Minor | | Moderate | | Major |
| Additional journey time delay | | < 1 min | 1-2 mins | | 2-3 mins | | 3 or more mins |
| No. travellers affected/ Duration of impact | | Significance of Effect | | | | | |
| | | <4 weeks | 4 weeks-4 months | 4 months or more | 4 weeks-4 months | 4 months or more | >4 weeks |
| <200 /day | Low | Not significant | Not significant | Not significant | Not significant | Not significant | Minor |
| Between 200-1,000 /day | Medium | Not significant | Not significant | Not significant | Minor | Minor | Moderate |
| >1,000 /day | High | Not significant | Minor | Minor | Moderate | Moderate | Major |

## 3.7 Accidents and safety

3.7.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

## Stage 1 - SMR criteria

3.7.2 Significant impacts on accidents and safety risks will be defined for links and junctions as follows:

- links and junctions for which data is available that have experienced on average more than nine personal injury accidents (PIA) in total, in a three-year period ending in 2011-12 and which would be subject to an increase of 30% or more in total traffic flow during construction for a period of more than four consecutive weeks in any 12 month period.

## Stage 2 – refinement of criteria

3.7.3 Where accident data has been collected for a period greater than three years, the number of accidents should be pro-rata to represent three years worth of data. Thus, for example, if five years worth of data were available, the number of accidents being considered would be multiplied by 3/5 (i.e. 0.6) and then the resultant number would be compared to the threshold of 9 accidents in total in the desired three year period.

3.7.4 The criteria shown in Table 17 should be applied in Stage 2.

Table 17: Criteria for Stage 2 assessment – accidents and safety

| ASSESSMENT OF ACCIDENTS AND SAFETY DURING CONSTRUCTION | | | | | |
|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | |
| | | Not significant | Minor | Moderate | Major |
| Change in Annual Average Daily Traffic (AADT) flow | | <30% | 30-60% | 60-120% | 120% or more |
| Number of PIAs within 20m of any impacted junctions | | <9 | 9 or more | 9 or more | 9 or more |
| Number of PIAs within any 150m section of impacted road links | | <9 | 9 or more | 9 or more | 9 or more |
| Number of travellers affected | | Significance of effect | | | |
| 10% or more below average benchmark national accident rate for category of road | Low | Not significant | Minor | Minor | Moderate* |
| Within +/- 10% of the average benchmark national accident rate for category of road | Medium | Not significant | Minor | Moderate* | Major* |
| 10% or more above average benchmark national accident rate for category of road | High | Not significant | Moderate* | Major* | Major* |

Note: * needs to be subject to further analysis within the Transport Assessment process.

3.7.5 Professional judgement should be used in considering whether or not the future flows are likely to increase the risks of accidents. This should include consideration of the local conditions on the highways and junctions and the factors causing the accidents. Sections of roads or junctions that have an identifiable cluster or gathering of accidents should be identified and addressed as necessary. Consideration should be given to the expected typical national average accident rate on this category of road, and whether or not this is being exceeded.

3.7.6 The grouping of accidents to establish whether the criteria of nine or more recorded PIA in total over a three year period is exceeded, should be based upon the following definition of clusters of accidents:

- nine or more recorded PIA in total over a three year period within about 20m of any road junction; or
- nine or more recorded PIA in total over a three year period within about 150m along any road link.

## 3.8 Severance

3.8.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

### Stage 1 - SMR criteria

3.8.2 Severance can affect travellers using non-motorised modes, especially pedestrians. Where reasonable, practically and economically, public footpaths and routes will be reinstated or alternatives provided. Cyclists and equestrians are less susceptible to severance because they can travel more quickly than people on foot, although there may still be significant impacts on these groups. Severance[3] effects will be classified according to the following four broad levels: no impact, minor, moderate and major.

3.8.3 To ensure a consistent approach, the classification and assessment will be based only on the characteristics that would exist assuming the movement was made by a pedestrian. The proposed categories of effect are discussed below.

3.8.4 Minor: In general the current journey pattern is likely to be maintained, but there may be some hindrance to movement for example:

- pedestrians at-grade crossing of a new road carrying less than 8,000 vehicles per day (annual average daily traffic - AADT); or
- a new bridge which will need to be climbed or a sub-way traversed; and/or
- journey lengths being increased by up to 100-250m (less than 100m increase in journey length is considered to be of no impact).

3.8.5 Moderate: Some residents, particularly children and elderly people, are likely to be dissuaded from making trips. Other trips will be made longer or less attractive, for example:

- two or more of the hindrances set out under `minor' applying to an individual journey; or
- pedestrians at-grade crossing of a new road accommodating between 8,000-16,000 vehicles per day (AADT) in the opening year; and/or
- journey lengths being increased by 250 – 500m.

[3] Based on Department for Transport (DfT) WebTAG Unit 3.6.2 and Design Manual for Roads and Bridges (DMRB) Volume 11, Section 11, Part 8.

- Major: People are likely to be deterred from making trips to an extent sufficient to induce a change in their habits. This could lead to a change in the location of centres of activity or in some cases to a permanent loss to a particular community. Alternatively, considerable hindrance will be caused to people making their existing journeys. Such impacts can result from:
- pedestrians at-grade crossing of a new road carrying over 16,000 vehicles per day (AADT) in the opening year;
- journey lengths being increased by over 500m; and/or
- three or more of the hindrances set out under 'minor' or two or more set out under 'moderate'.

3.8.6 An overall assessment for the option will then be based on the following guidelines (in each case, the assessment is beneficial if severance is reduced and adverse if severance is increased):

- the overall assessment is likely to be of negligible impact if increases in severance are broadly balanced by relief of severance;
- the overall assessment is likely to be minor where change in severance is slight or the total numbers of people affected across all levels of severance is minor (less than 200 per day);
- the overall assessment is likely to be major where the change in severance is major, and affects a moderate or high number of people or the total numbers of people affected across all levels of severance is major (greater than 1,000 per day); and
- the overall assessment is likely to be moderate where greater than 200 and less than 1,000 people per day are affected.

3.8.7 Table 18 sets out the criteria presented in the SMR Addendum. This is equivalent to Webtag's guidance on how severance without and with schemes are combined to estimate the significance of the effects in terms of severance.

Table 18: Assessment of Change in Severance Scoring

| | **Change in severance scoring with the Proposed Scheme** | | | |
|---|---|---|---|---|
| Numbers of travellers affected | Not significant | Minor | Moderate | Major |
| Minor | Not significant | Minor | Minor | Minor*/Moderate** |
| Moderate | Not significant | Minor | Moderate | Major |
| Major | Not significant | Minor | Major | Major |

Notes: * duration between 4 weeks and 4 months; and
** duration 4 months or more

Source: SMR Addendum

## Stage 2 – refinement of criteria

3.8.8 Effects that are of duration less than 4 consecutive weeks in any 12 month period will be assessed as being not significant.

3.8.9 The definition of significance in Table 19 includes the criteria in paragraphs 3.8.4 to 3.8.6 to assess the change in severance impact and the numbers of travellers affected as from paragraph 3.8.7.

3.8.10 The assessment criteria shown in Table 19 should be applied in Stage 2.

Table 19: Criteria for Stage 2 assessment – severance

| ASSESSMENT OF SEVERANCE DURING CONSTRUCTION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | | | | |
| | | Not significant | Minor | | Moderate | | Major | |
| Incremental hindrances | | N/A | As below | | 2 or more minor | | 3 or more minor or 2 or more moderate | |
| Veh/day for additional at grade crossings to be traversed | | N/A | <8,000 | | 8,000-16,000 | | 16,000 or more | |
| Change in journey length | | <100m | 100-250m | | 250-500m | | 500-1,500m | 1,500m or more |
| No. travellers affected/ Duration of impact | | Significance of Effect | | | | | | |
| | | <4 weeks | 4 weeks-4 months | 4 months or more | 4 weeks-4 months | 4 months or more | 4 weeks-4 months | 4 months or more |
| <200 people/day | Low | Not significant | Minor | Minor | Minor | Minor | Minor | Moderate |
| Between 200-1,000 people/day | Medium | Not significant | Minor | Minor | Moderate | Moderate | Major | Major |
| >1,000 people/day | High | Not significant | Minor | Minor | Major | Major | Major | Major |

## 3.9 Waterways

3.9.1 The SMR criteria have been considered with further refinement being added in Stage 2 in terms of how the extent of the numerical measures should be judged and the adoption of a graduated approach to the definition of the degree of significance of the effect.

### Stage 1 - SMR criteria

3.9.2 The document Third Party Works Procedures, Section 2, Code of Practice, British Waterways, 2012[4] (in Sections 4.1 – 4.3) identifies the requirements that have to be followed in relation to works affecting the navigation or amenity of canals. In summary, these are that generally no stoppages of the canal or navigation or towpath will be allowable, except for technical reasons. Stoppages must be discussed and agreed in advance with Canal and River Trust (formerly known as British Waterways) and all stoppages must be of minimised duration. For the purpose of the ES, a significant stoppage is defined as occurring when an unbroken stoppage exceeding six weeks in duration is required, as this is when specific arrangements regarding the transfer of boats around the works by road may be required.

### Stage 2 – refinement of criteria

3.9.3 For the purpose of the ES, a stoppage of less than six weeks will be considered not significant. Significant effects arising from stoppages are defined as:

[4] British Waterways (2012), Third Party Works Procedures.

- minor: when an unbroken stoppage exceeding six weeks in duration is required;
- moderate: when an unbroken stoppage exceeding 12 weeks is required; and
- major: when an unbroken stoppage exceeding 24 weeks is required.

3.9.4 The Canal and River Trust also require that towing paths must remain open wherever possible. If a diversion is unavoidable, these should be localised. They may be used by the Canal and River Trust maintenance plant and be of a standard to allow continued use by existing visitors – walkers, anglers, people with disabilities, cyclists etc. Only as an unusual event would towing paths be permitted to be used for access to the temporary and permanent works for the Proposed Scheme because of conflict with visitors and the unsuitability of the towing path for vehicular use. Any impacts on pedestrians, cyclists, mobility impaired persons and equestrians using the towing paths should be assessed in relation to the vulnerable road user and ambience heading and associated criteria.

# 4 Significance criteria for operational assessment

## 4.1 Introduction

4.1.1 The criteria outlined in this chapter will be used to assess the significance of traffic and transport impacts and effects during the operational phase of the Proposed Scheme.

## 4.2 Public transport delay

4.2.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

### Stage 1 - SMR criteria

4.2.2 Significant permanent impacts on journeys by bus, heavy and light rail, and London Underground affected by the Proposed Scheme will be identified from the traffic and transport assessment and the transport modelling result; and are defined as any of the following:

- a 10% change in a majority of journey times by any public transport mode; and
- a change in journey distances by bus of more than 400m in urban areas and 1km in rural areas.

### Stage 2 – refinement of criteria

4.2.3 In the consideration of these criteria for the construction phase, as described in paragraph 3.2.2, account was taken of changes in journey times and distances; delays, disruption, overcrowding; and changes to service frequencies, capacity, loss of through connections and reductions in hours of services. Whilst many of these impacts will be taken account of within the design of the facilities, they will also be assessed for the operational phase of the Proposed Scheme. If there are any significant effects these will be reported.

4.2.4 The bus journey times to be considered are the typical journey times that would be expected over the additional distance introduced as a result of the intervention, rather than specifically those of individual passengers journeys.

4.2.5 The criteria shown in Tables 20 and 21 should be applied in Stage 2, respectively in rural and urban situations.

Table 20: Criteria for Stage 2 assessment – public transport delay, rural

| **ASSESSMENT OF PUBLIC TRANSPORT DELAY DURING OPERATION - RURAL** | | | | | |
|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | |
| | | Not significant | Minor | Moderate | Major |
| Percentage change in route end-to-end journey time | | <10% | 10-20% | 20-40% | 40% or more |
| Distance change | | <1km | 1-2km | 2-4km | 4km or more |
| No. of travellers affected | | Significance of effect | | | |
| <3 buses or trains/hr | Low | Not significant | Minor | Moderate | Moderate |
| Between 3-6 buses or trains/hr | Medium | Not significant | Moderate | Major | Major |
| >6 buses or trains/hr | High | Not significant | Moderate | Major | Major |

Table 21: Criteria for Stage 2 assessment – public transport delay, urban

| **ASSESSMENT OF PUBLIC TRANSPORT DELAY EFFECTS DURING OPERATION - URBAN** | | | | | |
|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | |
| | | Not significant | Minor | Moderate | Major |
| Percentage change in route end-to-end journey time | | <10% | 10-20% | 20-40% | 40% or more |
| Distance change | | <400m | 400-800m | 800-1,200m | 1,200m or more |
| No. of travellers affected | | Significance of effect | | | |
| <8 buses or trains/hr<br>OR<br><5,000 passengers/day | Low | Not significant | Minor | Moderate | Moderate |
| Between 8-20 buses or trains/hr<br>OR<br>Between 5,000 and 10,000 passengers/day | Medium | Not significant | Moderate | Major | Major |
| >20 buses or trains/hr<br>OR<br>Over 10,000 passengers/day | High | Not significant | Moderate | Major | Major |

## 4.3 Station/interchange impacts

4.3.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

### Stage 1 - SMR criteria

4.3.2 The SMR defines the significance criteria as impacts that may be caused by additional passengers of the Proposed Scheme arriving and departing at the stations/interchanges. This will be assessed using modelling information, taking account of:

- forecast numbers of additional passengers using the Proposed Scheme;
- local transport conditions at each location;
- resulting increases in crowding and congestion levels arising from increased usage or changed journey patterns arising from the arrival and departure, by all available modes, of passengers using the Proposed Scheme; and
- any loss of physical linkage for the next stage of the journey.

### Stage 2 – refinement of criteria

4.3.3 The results from the traffic and transport assessment and modelling will be used to identify if there are any significant journey time, interchange and accessibility changes for travellers. This will include consideration of:

- resulting increases in crowding and congestion levels arising from increased usage or changed journey patterns arising from the arrival and departure, by all available modes, of passengers using the Proposed Scheme. Where relevant these will be quantitatively assessed using the transport models developed within the Transport Assessment. Criteria that will be assessed include:
  - Results of pedestrian capacity modelling, where there is a change (increase) of at least one Fruin Level of Service (LoS), based on TfL station passenger standards and guidelines.[5]
  - Likelihood of congestion causing delays at the kerbside or at station facilities e.g. bus station or taxi ranks.
- Any loss of physical linkage for the next stage of the journey.

4.3.4 It is however expected that the new transport infrastructure will be designed to cater for the forecast levels of future demands and mitigate any impacts that the Proposed Scheme might otherwise have been expected to cause.

4.3.5 The criteria shown in Table 22 should be applied in Stage 2

[5] TfL London Underground S1371 Station Planning, Issue A5, Issue date: June 2011.

Table 22: Criteria for Stage 2 assessment – station/interchange impacts

| ASSESSMENT OF DISRUPTION AT STATIONS/ INTERCHANGES DURING OPERATION | | | | | |
|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | |
| | | Not significant | Minor | Moderate | Major |
| Pedestrian modelling (Fruin LoS) | | C or less | D increased by 2 or more levels or E increased by 1 level | E increased by 2 or more levels or F increased by 1 level | F increased by 2 or more levels |
| No. of travellers affected | | Significance of effect | | | |
| See Table 8 above | Low | Not significant | Minor | Moderate | Moderate |
| See Table 8 above | Medium | Not significant | Moderate | Major | Major |
| See Table 8 above | High | Not significant | Moderate | Major | Major |

### Guidance on terminology

4.3.6 The following guidance on terminology is highlighted:

- resulting increases in congestion levels will be as assessed and informed by the transport assessment and modelling;
- the loss of a physical linkage is the inability to make a direct connection.

## 4.4 Traffic flows and delays to vehicle occupants

4.4.1 Further refinement has been added to the SMR criteria in Stage 2 in terms of how the numerical measures should be judged along with the adoption of a graduated approach to the definition of the degree of significance of the effect.

### Stage 1 - SMR criteria

4.4.2 The SMR criteria include that a significant impact in traffic levels (i.e. HGVs and all vehicles) and driver and vehicle passenger delay will be defined as any of the following:

- a 10% increase in peak hour two-way traffic flows;
- increases in traffic flows that cause the design capacity to become exceeded, on links that would not otherwise be congested;
- a 30% increase in the average off-peak hour two-way traffic flows;
- a permanent diversion that results in an increase in journey length of more than 1km; and
- where a significant change in delay relating to junction congestion resulting from the operation of the Proposed Scheme is forecast in the traffic and transport Assessment and the outputs from the traffic modelling. The junctions for consideration will be discussed with the local Highways Authority, based on the increase in the level of congestion at the location. This will be measured with congestion indicators based on the forecast ratio of flow to

capacity (RFC), degree of saturation (DoS) or the practical reserve capacity (PRC).

## Stage 2 – Refinement of Criteria

4.4.3 The criteria shown in Tables 23 to 26 should be applied in Stage 2 in relation to the impacts and effects during the operational stage of the Proposed Scheme.

4.4.4 These criteria have been further developed, and slightly amended from those in the SMR, to include in the assessment of the operational scenario the same application of "HGV or all vehicle" thresholds as adopted in the assessment of the construction scenario. This has been adopted to clarify that these two categories of vehicles both need to be assessed, separately.

4.4.5 The daily HGV or all vehicle thresholds in Table 23 will, where relevant, be adjusted accordingly to peak hour flows, if necessary, to correspond with the peak hour data that will be used in this assessment.

Table 23: Criteria for Stage 2 assessment –traffic flows and delays to vehicle occupants (traffic severance)

| **ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Severance) DURING OPERATION** | | | | | |
|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | |
| | | Not significant | Minor | Moderate | Major |
| Increase in peak hour traffic flows (HGVs or all vehicles ) where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas | | <10% | 10-20% | 20-40% | 40% or more |
| Increase in off-peak hour traffic flows (HGVs or all vehicles ) where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas | | <30% | 30-60% | 60-120% | 120% or more |
| No. of travellers affected | | Significance of effect | | | |
| Road can be safely and easily crossed (<250 veh/hr inc. Proposed Scheme traffic), safe crossing facilities available | Low | Not significant | Minor | Moderate | Moderate |
| Road moderately difficult to cross safely (250-750 veh/hr inc. Proposed Scheme traffic), lack of safe crossing facilities available | Medium | Not significant | Moderate | Major | Major |
| Road difficult to cross safely, controlled crossing facility required (>750 veh/hr inc. Proposed Scheme traffic), lack of safe crossing facilities available | High | Not significant | Moderate | Major | Major |

Table 24: Criteria for Stage 2 assessment –traffic flows and delays to vehicle occupants (traffic diversion)

| **ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Diversions) DURING OPERATIONS** | | | | | |
|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | |
| | | Not significant | Minor | Moderate | Major |
| Diverted distance | | <1km | 1-5km | 5-10km | 10km or more |
| No. of travellers affected | | Significance of effect | | | |
| Between 100-1,000 veh/day | Low | Not significant | Minor | Moderate | Moderate |
| Between 1,000- | Medium | Not significant | Moderate | Major | Major |

| ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCUPANTS (Traffic Diversions) DURING OPERATIONS | | | | | |
|---|---|---|---|---|---|
| 10,000 veh/day | | | | | |
| >10,000 veh/day | High | Not significant | Moderate | Major | Major |

Table 25: Criteria for Stage 2 assessment – traffic flows and delays to vehicle occupants (traffic congestion), rural

| ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCULANTS (traffic congestion) DURING OPERATION - RURAL | | | | | |
|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | |
| | | Not significant | Minor | Moderate | Major |
| Change in peak hour traffic flow | | <2% | N/A | N/A | N/A |
| Reserve junction capacity (including Proposed Scheme traffic) | | >15% | 8-15% | 2-8% | <2% |
| No. of travellers affected | | Significance of effect | | | |
| <2% change in reserve capacity | Very Low | Not significant | Not significant | Not significant | Not significant |
| 2-5% change in reserve capacity | Low | Not significant | Minor | Minor | Moderate |
| Between 5-10% change in reserve capacity | Medium | Not significant | Minor | Moderate | Major |
| >10% change in reserve capacity | High | Not significant | Minor | Major | Major |

Table 26: Criteria for Stage 2 Assessment – traffic flows and delays to vehicle occupants (traffic congestion), urban

| ASSESSMENT OF TRAFFIC FLOWS AND DELAYS TO VEHICLE OCCULANTS (Traffic Congestion) DURING OPERATION - URBAN | | | | | |
|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | |
| | | Not significant | Minor | Moderate | Major |
| Future with-scheme Congestion Indicator | | <85% | 85 - 92% | 92 - 98% | 98% or more |
| No. of travellers affected | | Significance of effect | | | |
| <2% change in reserve capacity | Very Low | Not significant | Not significant | Not significant | Not significant |
| 2-5% change in Congestion Indicator | Low | Not significant | Minor | Minor | Moderate |
| Between 5-10% change in Congestion Indicator | Medium | Not significant | Minor | Moderate | Major |
| >10% change in Congestion Indicator | High | Not significant | Minor | Major | Major |

## Guidance on terminology

4.4.6 The following guidance on terminology is highlighted:

- a significant change in delay will be as assessed and informed by the Transport Assessment.

## 4.5 Parking and loading

4.5.1 The assessment criteria for the operational phase of the Proposed Scheme will be the same as those described for the longer term impacts that may occur during the construction phase. . These are shown in Table 27 below.

Table 27: Criteria for Stage 2 Assessment – Parking and loading

| ASSESSMENT OF PARKING AND LOADING DURING OPERATION | | | | | |
|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | |
| | | Not significant | Minor | Moderate | Major |
| Change in parking demand (number or %) | | <10 | 10-20 | 20-40 | >40 |
| Change in number of designated parking spaces | | 0 | 1 | 2-4 | 4 or more |
| Change in availability of cycle or motorcycle spaces (number or %) | | <10 | 10-20 | 20-40 | >40 |
| Proximity of alternative parking spaces | | Significance of Effect | | | |
| <100m | Low | Not significant | Minor | Moderate | Moderate |
| Between 100-250m | Medium | Not significant | Moderate | Major | Major |
| >250m | High | Not significant | Moderate | Major | Major |

## 4.6 Vulnerable road user delay, amenity and ambience

4.6.1 The assessment criteria for the operational phase of the Proposed Scheme are the same as those described for the longer term impacts that may occur during the construction phase. These are shown in Table 28.

Table 28: Criteria for Stage 2 assessment – vulnerable road user delay, amenity and ambience

| ASSESSMENT OF VULNERABLE ROAD USER DELAY, AMENITY AND AMBIENCE EFFECT DURING OPERATION | | | | | |
|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | |
| | | Not significant | Minor | Moderate | Major |
| Additional journey time delay | | < 1 min | 1-2 mins | 2-3 mins | 3 or more mins |
| No. of travellers affected | | Significance of effect | | | |
| <200 /day | Low | Not significant | Not Significant | Not Significant | Minor |
| Between 200-1,000 /day | Medium | Not significant | Not significant | Minor | Moderate |
| >1,000 /day | High | Not significant | Minor | Moderate | Major |

## 4.7 Accidents and safety

4.7.1 The assessment criteria for the operational phase of the Proposed Scheme will be the same as those described in Section 3.7 for the construction phase (see Table 17).

## 4.8 Severance

4.8.1 The assessment criteria for the operational phase of the Proposed Scheme are the same as those described for the longer term impacts that may occur during the construction phase. These are shown in Table 29.

Table 29: Criteria for Stage 2 Assessment – Severance

| ASSESSMENT OF SEVERANCE DURING OPERATION | | | | | | |
|---|---|---|---|---|---|---|
| Criteria | | Magnitude of impacts | | | | |
| | | Not significant | Minor | Moderate | Major | |
| Incremental hindrances | | N/A | As below | 2 or more minor | 3 or more minor or 2 or more moderate | |
| Veh/day for additional at grade crossings to be traversed | | N/A | <8,000 | 8,000-16,000 | 16,000 or more | |
| Change in journey length | | <100m | 100-250m | 250-500m | 500-1,500m | 1,500m or more |
| No. of travellers affected | | Significance of effect | | | | |
| <200 people/day | Low | Not significant | Minor | Minor | Minor | Moderate |
| 200-1,000 people/day | Medium | Not significant | Minor | Moderate | Major | Major |
| >1,000 people/day | High | Not significant | Minor | Major | Major | Major |

## 4.9 Waterways

4.9.1 The assessment criteria for the operational phase of the Proposed Scheme will be the same as those described above for the construction phase (see Section 3.9).

# Annex J: Waste and material resources– technical notes

1.1.1 The following technical notes are appended to this document:

- Rationale for landfill significance criteria
- Waste forecast and assessment methodology

# HS2 London-West Midlands

# Waste and material resources

# Technical note – Rationale for landfill significance criteria

## A report to HS2 Ltd by Arup/URS

# Contents



**List of figures**

**List of tables**

# 1 Introduction

## 1.1 General

1.1.1 This technical note sets out the rationale for the development of the significance criteria for inert, non-hazardous and hazardous landfill to be used in the assessment of the likely significant environmental effects associated with the disposal of solid waste arising from the Proposed Scheme.

1.1.2 There is no Environmental Impact Assessment (EIA) guidance in the UK which provides an authoritative methodology and waste significance criteria for the assessment of the likely significant environmental effects of solid waste generation. EIA guidance for other countries exists (for example Hong Kong) but this sets out significance criteria based on qualitative factors.

1.1.3 'CLG Circular 02/99: Environmental impact assessment'[1] states that an EIA is likely to be required for a landfill site for the disposal of household, industrial and/or commercial waste where new capacity is created to hold more than 50,000 tonnes per annum, or to hold waste of 10 hectares or more. More importantly, it also states that sites seeking only to accept inert wastes (demolition waste etc.) are unlikely to require an EIA (see Appendix A).

1.1.4 The Design Manual for Roads and Bridges[2] does not set any criteria for assessing waste arising as a result of the construction of roads or bridges.

# 2 Rationale for inert landfill significance criteria

## 2.1 General

2.1.1 This section of the technical note sets out the rationale for the development of the significance criteria for inert landfill to be used in the assessment of the significance of environmental effects associated with the disposal of inert waste arising from the Proposed Scheme.

## 2.2 Inert waste legislative guidance

2.2.1 Guidance by the Environment Agency provides a definition for inert waste as per the EU Landfill Directive, article 2(e):[3]

*'Inert waste' means waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater;'.*

[1] Department for Communities and Local Government (1999), *Environmental impact assessment: circular 02/1999.*
[2] Department of Transport (2001), *The Design Manual for Roads and Bridges, Volume 11, Section 3, Part 6.*
[3] Environment Agency (June 2009), *Environmental Permitting Regulations: Inert Waste Guidance. Standards and Measures for the Deposit of Inert Waste on Land.*

2.2.2 The EU Landfill Directive sets rigorous standards to reduce the impact from waste disposed of to landfill including inert waste acceptance criteria.

2.2.3 The Environment Agency Technical Guidance WM2 'Hazardous Waste',[4] although intended for hazardous waste assessment, provides a useful waste assessment methodology and guidance on waste classification using the European Waste Catalogue, transposed into English legislation by the List of Wastes (England) Regulations 2005 (SI 2005 No. 895) (as amended).

2.2.4 Inert waste is likely to comprise those wastes stated in the List of Wastes (England) Regulations 2005 (SI 2005 No. 895) (as amended) in Chapter 17 'Construction and Demolition Wastes (including excavated soils from contaminated sites)'.[5] However, if no suitable waste codes are available in Chapter 17 then other chapters will need to be explored, for example, Chapter 1 'Wastes Resulting from Exploration, Mining, Quarrying, and Physical and Chemical Treatment of Minerals' or Chapter 19 'Waste from Waste Treatment Facilities'.

2.2.5 The EU Landfill Directive 99/31/EC defines landfill as waste disposal sites for the deposit of waste onto or into land and divides landfill into three classes: (i) landfills for hazardous waste; (ii) landfills for non-hazardous waste; and (iii) landfill for inert waste.

## 2.3 Other major infrastructure projects

2.3.1 EIAs for other major infrastructure projects such as Crossrail have relied on a qualitative assessment. The Crossrail target for diverting excavation materials from landfill is 95% with a stretch target of 100%. The target for diverting construction and demolition waste from landfill is 90%. The forecast material generation for Crossrail is set out in Table 1 below. The figures include a bulking factor (i.e. increase in volume following excavation).

Table 1: Crossrail excavated material classification

| Material Classification | Volume ($m^3$) |
|---|---|
| Clean excavated material (non-contaminated)* | 6.0 million |
| Construction material | 1.2 million |
| Contaminated material | 0.5 million |
| Demolition material | 0.3 million |

*Crossrail has stated the following: 'All of Crossrail's 5.6 million $m^3$ of clean excavated material will be beneficially reused'.

2.3.2 The Olympic Delivery Authority (ODA) set targets of reclaiming 90% of demolition waste by weight for reuse and recycling, and to divert 90% of construction waste from landfill for construction of the facilities for the London 2012 Olympic Games. The ODA recycled 97.7% of demolition waste and achieved their target for diversion of construction waste from landfill. Additionally, 80% of contaminated soil was cleaned and reused through the use of soil washing and bioremediation technologies. This equated to 1.3 million tonnes of soil.

2.3.3 The Thames Tunnel project has a target to divert a minimum of 90% of construction, demolition and excavated material from landfill. The 'Preliminary Environmental Information Report (Volume 5: Assessment methodologies)'[6] does not provide a

[4] Environment Agency (April 2011), Technical Guidance WM2: Hazardous Waste.
[5] HMSO (2005), *The List of Wastes (England) Regulations.*
[6] Thames Water (2011), *Preliminary Environmental Information Report: Volume 5 Assessment Methodology.*

specific assessment methodology for waste. It is stated that: 'Contaminated and uncontaminated soils from excavations will be required to be handled and managed as part of the waste strategy for the project.' The draft waste strategy (Phase 2 Consultation, Autumn 2011)[7] does also not include an assessment methodology or criteria for waste. However, it includes an appraisal of the disposal of waste on the 'Impact on regional self-sufficiency and apportionment' but does not provide any statement on its significance.

## 2.4 Inert waste management infrastructure

2.4.1 The number of material recovery facilities for inert and non-inert (mixed) construction and demolition materials has increased over the past 10 years contributing to improved resource efficiency in the construction industry. It is possible for a single construction and demolition waste recovery facility to be capable of processing significantly in excess of one million tonnes of inert waste per annum. For example, the Powerday facility in North West London is licensed to process 1.6 million tonnes per annum on a site of approximately 3.5 hectares[8]. The Bedrock Thames Wharf site in East London is licensed to process 750,000 tonnes per annum on a 1.36 hectare site[9].

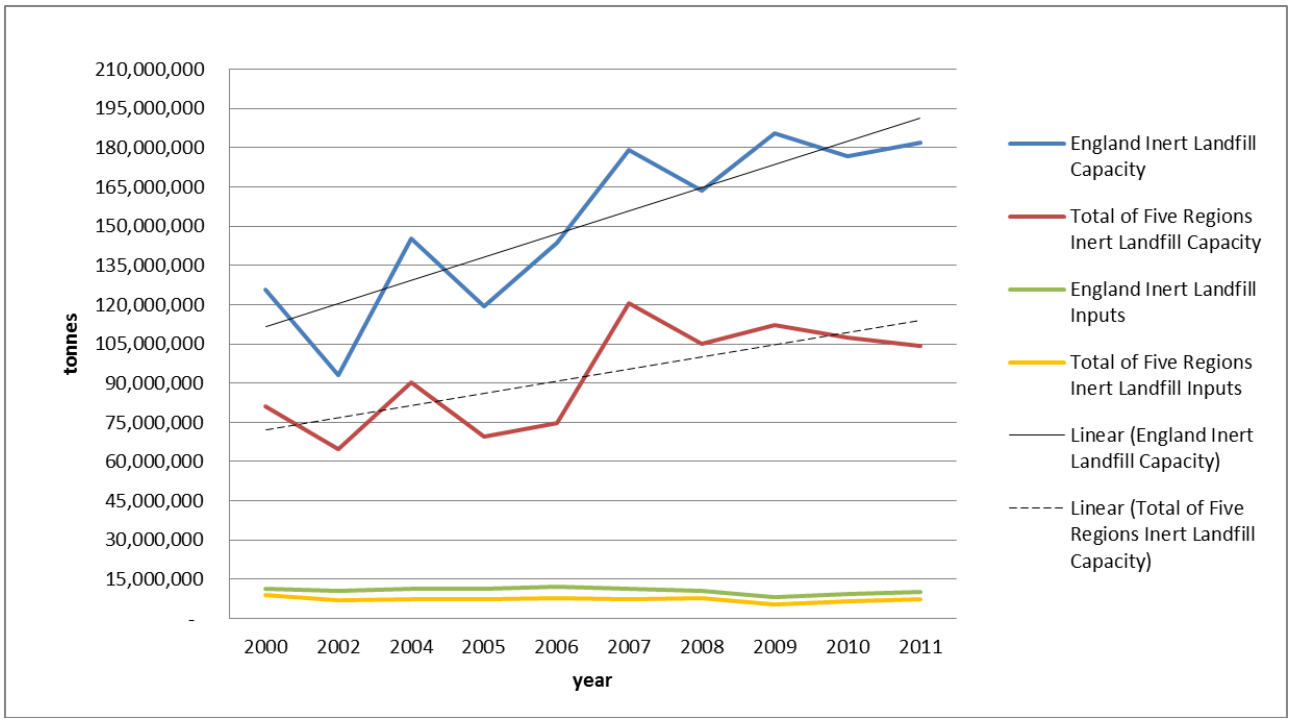
2.4.2 Typically, a large proportion of inert waste, which is destined for landfill disposal, is used for landfill engineering and capping purposes.

2.4.3 Latest available data published by the Environment Agency[10] shows that inert landfill capacity in England has almost doubled over a period of 10 years from 93 million tonnes in 2001 to over 181 million tonnes in 2011, as shown in Figure 1. The data show that inert landfill capacity in the five former planning regions (i.e. Greater London, South East, East of England, East Midlands and West Midlands) along the route corridor of the Proposed Scheme (hereafter referred to as the 'five regions') has also increased from almost 65 million tonnes in 2001 to over 104 million tonnes in 2011 but has declined slightly since 2009 (see Figure 1).

2.4.4 The data show that inert landfill inputs in England between 2000 and 2011 have been relatively stable on average with just under 11 million tonnes per annum. The average total of the five regions was slightly over six million tonnes over the same period (see Figure 1).

[7] Thames Water (2011), *Thames Tunnel Draft Waste Strategy.*
[8] Powerday; Construction & Demolition; http://www.powerday.co.uk/recycling-solutions/construction-demolition; accessed: 5 July 2013
[9] Greater London Authority; Planning Reports PDU/1125/01 & 1555/01, 7 November 2006 – Thames Wharf Olympic Business Relocations, Dock Road, Silvertown; http://legacy.london.gov.uk/mayor/planning_decisions/strategic_dev/2006/20061129/thames_wharf_report.pdf; accessed 8 July 2013.
[10] Environment Agency; Waste Data Tables, England and Wales – Landfill Capacity Trends 2000-2011; http://www.environment-agency.gov.uk/research/library/data/142773.aspx; accessed: 24 June 2013.

Figure 1: Inert landfill capacity and inputs in England/five regions (2000 to 2011)




## 2.5 Inert landfill significance criteria

2.5.1 The significance criteria in Table 2 have been developed for inert landfill (excluding hazardous substances) as part of the Scope and Methodology Report (SMR - see Volume 5 Appendix CT001-000/1). They are relevant for inert waste, which may arise from site clearance works, demolition of existing buildings and structures, and the earthworks associated with the construction of the Proposed Scheme.

Table 2: Inert landfill significance criteria (excluding hazardous substances)

| Degree of significance | Inert landfill criteria |
|---|---|
| Major adverse | Net increase in waste arisings relative to the future baseline leading to a severe, national and regional scale reduction in inert landfill void space capacity. Need for additional large-scale waste treatment and/or disposal capacity of greater than 10,000,000 tonnes per annum. Effect may be judged to be of importance in the national planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in the decision making. |
| Moderate adverse | Net increase in waste arisings relative to the future baseline leading to a regional scale reduction in inert landfill void space capacity. Need for additional medium to large scale waste treatment and/or disposal capacity of between 2,000,000 to 10,000,000 tonnes per annum. Effect may be judged to be important in the regional planning context, for example, where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required. |
| Minor adverse | Net increase in waste arisings relative to the future baseline leading to local scale reduction in inert landfill void space capacity. Need for additional small scale waste treatment and/or disposal capacity of up to 2,000,000 tonnes per annum. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project. |
| Negligible | No significant increase in waste arisings relative to the future baseline or reduction in inert landfill void space capacity. No appreciable adverse or beneficial effects. |
| Beneficial | Net reduction in waste arisings and diversion of waste from inert landfill relative to the future baseline resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure. |

2.5.2 The upper 'threshold value' for minor adverse effects has been set as 2,000,000 tonnes per annum of inert landfill disposal capacity. This threshold has been based on providing additional small scale inert landfill disposal capacity equivalent to a 10 hectare inert landfill site assuming an inert waste thickness of approximately 15m (i.e. 1,500,000$m^3$ of inert landfill capacity or approximately 2,000,000 tonnes using a volume to mass density conversion factor of 1.5 tonnes/$m^3$)[11]. Based on the threshold described in Circular 02/99 and the inert nature of the waste (i.e. reduced potential of generating greenhouse gas emissions and leachate), it is considered unlikely that landfill and/or land raise would result in pollution of the environment and/or harm to human health. This would need to be confirmed when applying for an environmental permit for an individual site.

2.5.3 The disposal of 2,000,000 tonnes per annum of inert waste would represent about 2% of the inert landfill capacity in the combined five regions, and 1% of the national inert landfill capacity, based on the most recently available figures for 2011 from the Environment Agency[12].

2.5.4 The threshold values for moderate and major adverse environmental effects have been based on professional judgement. These are extrapolations of the threshold value for minor adverse environmental effects based on an incremental increase of the total inert waste quantity to be disposed of by applying a factor of five to define the moderate adverse environmental effects threshold value (i.e. 2,000,000 to 10,000,000 tonnes per annum), and the major adverse environmental effects threshold value (i.e. greater than 10,000,000 tonnes per annum).

2.5.5 The disposal of 10,000,000 tonnes per annum of inert waste represents approximately 10% of the total inert landfill capacity in the combined five regions, and approximately 6% of inert landfill capacity in England based on the 2011 inert landfill capacity data from the Environment Agency.

2.5.6 The Proposed Scheme would be constructed over a period of approximately nine years (i.e. 2017 to 2025) starting initially with enabling works followed by the earthworks such as tunnelling etc. Any inert surplus excavated material generated by the Proposed Scheme would not occur all in a single year but extend over several years reducing the pressure on inert landfill capacity.

2.5.7 A wide range of factors influence the available landfill capacity such as the regulatory regime, fiscal measures, waste generation rates and measures to divert waste from landfill (e.g. reuse, recycling/composting and energy recovery). This makes the forecasting of future landfill capacity difficult and inexact. It is recognised that landfill capacity is a limited resource, however, data from the Environment Agency indicates an increase in inert landfill capacity in the combined five regions and England between 2000 and 2011 (see Figure 1).

[11] Department of the Environment (1995), Waste Management Paper 26B, Landfill Design, Construction and Operational Practice.
[12] Environment Agency; Waste Data Tables, England and Wales – Landfill Capacity Trends 2000-2011; http://www.environment-agency.gov.uk/research/library/data/142773.aspx; accessed: 24 June 2013.

# 3 Rationale for non-hazardous landfill significance criteria

## 3.1 General

3.1.1 This section of the technical note sets out the rationale for the development of the significance criteria for non-hazardous landfill to be used in the assessment of the significance of environmental effects associated with the disposal of non-hazardous waste arising from the Proposed Scheme.

## 3.2 Non-hazardous waste legislative guidance

3.2.1 Non-hazardous waste means waste which is not hazardous (see Section 4 for hazardous). It will comprise waste generated during the construction (e.g. worker accommodation site waste) and operation (e.g. railway station and train waste) of the Proposed Scheme.

3.2.2 Non-hazardous waste is also covered by the revised EU Waste Framework Directive 2008/98/EC (rWFD), and UK waste policy, legislation and guidance.

3.2.3 Non-hazardous waste landfill sites typically accepted municipal solid waste along with non-hazardous waste (including inert waste) from any other sources. There are no numerical waste acceptance criteria for non-hazardous waste but the List of Waste Regulations provides absolute non-hazardous waste entries for wastes which are deemed to be non-hazardous. However, the main requirement is to ensure that the waste landfilled is not hazardous.

## 3.3 Other major infrastructure projects

3.3.1 As stated in Section 2, EIAs for other major infrastructure projects such as Crossrail have relied on a qualitative assessment, and have not developed assessment criteria for the disposal of non-hazardous waste.

## 3.4 Non-hazardous waste management infrastructure

3.4.1 Latest available data published by the Environment Agency[13] shows a downward trend of non-hazardous waste landfill capacity in England (indicated by the linear trend line) with about 450 million tonnes in 2005 declining to approximately 340 million tonnes in 2011 (approximately 24% reduction), as shown in Figure 2. Over the same period, the non-hazardous waste input rates have decreased even more steeply from 56 million tonnes to 34 million tonnes (approximately 39% reduction).

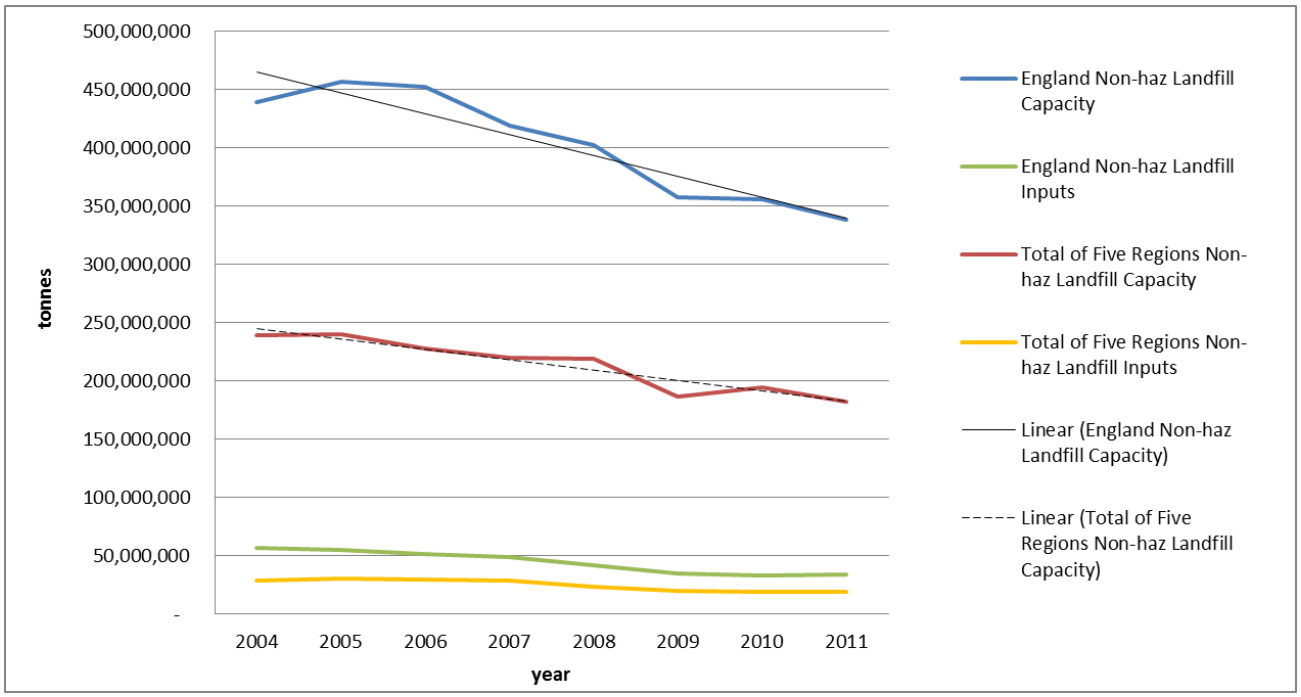
3.4.2 This downward trend is mainly driven by EU and UK sustainable waste management policy promoting the reduction and reuse of waste, increasing recycling and energy recovery and thereby reducing the quantity of biodegradable municipal waste being disposed of to landfill.

3.4.3 There has been a significant increase in the provision of alternative waste treatment infrastructure (e.g. materials recovery facilities, composting and anaerobic digestion

[13] Environment Agency; Waste Data Tables, England and Wales – Landfill Capacity Trends 2006-2011; http://www.environment-agency.gov.uk/research/library/data/142773.aspx (accessed 25/07/2013).

plants and waste to energy facilities) to enable the diversion of waste away from landfill.

Figure 2: Non-hazardous landfill capacity and inputs in England/five regions (2004 to 2011)




## 3.5 Non-hazardous landfill significance criteria

3.5.1 The significance criteria in Table 3 have been developed for non-hazardous waste landfill as part of the Scope and Methodology Report Addendum for the Proposed Scheme. They are relevant for non-hazardous waste, which will arise from the construction and operation of the Proposed Scheme.

Table 3: Non-hazardous landfill significance criteria

| Degree of significance | Non-hazardous landfill criteria |
|---|---|
| Major adverse | Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to a severe national and regional-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional large-scale waste treatment and/or disposal capacity of greater than 250,000 tonnes per annum. Effect may be judged to be of importance in the regional planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in decision-making. |
| Moderate adverse | Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to regional-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional medium-scale waste treatment and/or disposal capacity of between 50,000 to 250,000 tonnes per annum. Effect may be judged to be important in the local planning context, e.g. where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required. |
| Minor adverse | Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to local-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional small scale waste treatment and/or disposal capacity of up to 50,000 tonnes per annum. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project. |
| Negligible | No significant increase in waste arisings relative to the future baseline without the Proposed Scheme or reduction in landfill void space capacity for non-hazardous waste. No appreciable adverse or beneficial effects. |
| Beneficial | Net reduction in waste arisings and diversion of waste from landfill relative to the future baseline without the Proposed Scheme resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure. |

3.5.2 For minor adverse environmental effects, the upper threshold value has been set as 50,000 tonnes per annum. This threshold value has been selected with reference to the EIA Circular 02/99: Environmental Impact Assessment, which states in Annex A: Indicative Thresholds and Criteria for Identification of Schedule 2 Development Requiring EIA, 'Installation for the disposal of non-hazardous waste' A36: "...EIA is more likely to be required where new capacity is created to hold more than 50,000 tonnes per year...".

3.5.3 The threshold values for moderate and major adverse environmental effects have been based on professional judgement. These are extrapolations of the threshold value for minor adverse environmental effects based on an incremental increase of the total non-hazardous waste quantity to be disposed of by applying a factor of five to define the moderate adverse environmental effects threshold value of (i.e. 50,000 to 250,000 tonnes per annum), and the major adverse environmental effects threshold value (i.e. greater than 250,000 tonnes per annum).

3.5.4 The disposal of 250,000 tonnes of non-hazardous waste represents approximately 0.14% of the total non-hazardous landfill capacity in the combined five regions, and approximately 0.07% of non-hazardous landfill capacity in England based on the 2011 inert landfill capacity data from the Environment Agency[14]. Non-hazardous waste generated by the Proposed Scheme will arise during the nine year construction period (2017 to 2025), and also during the operational period starting in 2026.

3.5.5 The Proposed Scheme would be constructed over a period of nine years (i.e. 2017 to 2025) starting initially with enabling works followed by the earthworks such as tunnelling etc. Any non-hazardous waste generated during the construction period of the Proposed Scheme would not occur all in a single year, which will reduce the pressure on non-hazardous landfill capacity.

# 4 Rationale for hazardous landfill significance criteria

## 4.1 General

4.1.1 This section of the technical note sets out the rationale for the development of the significance criteria for the disposal of hazardous waste to be used in the assessment of the significance of environmental effects associated with the disposal of hazardous waste arising from the Proposed Scheme.

4.1.2 In determining the quantity of hazardous waste, the designers of the Proposed Scheme have considered the treatment of the hazardous waste on- and off-site to reduce its hazardousness and moving waste management up the waste hierarchy.

4.1.3 Hazardous waste covered by this technical note comprises contaminated soils (i.e. unacceptable material Class U2)[15], which cannot be remediated on- or off-site, and therefore are unacceptable for reuse within the engineering or environmental mitigation earthworks of the Proposed Scheme. It also covers hazardous waste

[14] Environment Agency; Waste Data Tables, England and Wales – Landfill Capacity Trends 2000-2011; http://www.environment-agency.gov.uk/research/library/data/142773.aspx (accessed 25/07/2013).
[15] Department for Transport (2009), Highways Agency, Manual of Contract Documents for Highway Works, Volume 1 – Specification for Highway Works, Series 600 Earthworks. http://www.dft.gov.uk/ha/standards/mchw/vol1/ (accessed 26/06/2013).

generated from demolition works associated with the construction of the Proposed Scheme. However, it does not include, for example, radioactive contaminated land or track ballast containing dangerous substances etc.

## 4.2 Hazardous waste legislative guidance

4.2.1 The rWFD provides a European-wide definition of hazardous waste. Hazardous waste is defined as a waste possessing one or more of the 15 hazardous properties set out in Annex III of the rWFD.

4.2.2 The rWFD also provides a list of wastes, known as the European Waste Catalogue (EWC), to classify wastes and identify those which are considered to be hazardous because of the hazardous properties set out in Annex III of the rWFD.

4.2.3 The EWC is a catalogue of all wastes, grouped according to generic industry, process or waste type. It differentiates between non-hazardous and hazardous by identifying hazardous waste entries with an asterisk (*).

4.2.4 The Hazardous Waste (England and Wales) Regulations 2005 (as amended) set out the regime for the control and tracking of the movement of hazardous waste for the purpose of implementing the EU Hazardous Waste Directive 91/689/EC[16].

4.2.5 The Environment Agency Technical Guidance WM2 'Hazardous Waste'[17] provides a definition for hazardous waste as per the rWFD. The technical guidance also provides a useful waste assessment methodology and guidance on waste classification using the EWC, transposed into English legislation by the List of Wastes (England) Regulations 2005 (SI 2005 No. 895) (as amended)[18].

## 4.3 National Policy Statement for hazardous waste

4.3.1 The Department for Environment, Food and Rural Affairs (Defra) National Policy Statement (NPS) for Hazardous Waste[19] provides planning guidance in relation to nationally significant hazardous waste infrastructure. The capacity threshold [20]stated in the NPS for hazardous waste landfill is 100,000 tonnes per annum, which in turn reflects the threshold set out in s.30 Planning Act 2008[21]. This threshold is based on total weight of waste and not just on the weight of any hazardous components.

## 4.4 Other major infrastructure projects

4.4.1 The London 2012 Olympic Park is constructed on land previously used by a variety of industries, which left a legacy of soil and groundwater contamination. The ODA used in-situ and ex-situ soil cleaning techniques to enable the reuse of 80% of contaminated soil thereby reducing the quantity of hazardous waste that required landfill disposal.

[16] The Hazardous Waste (England and Wales) Regulations 2005 (as amended). http://www.legislation.gov.uk/uksi/2005/894/contents/made (accessed 17/09/2013).
[17] Environment Agency (August 2013), *Technical Guidance WM2: Interpretation of the definition and classification of hazardous waste. http://www.environment-agency.gov.uk/business/topics/waste/32180.aspx (accessed 17/09/2013).*
[18] HMSO (2005), *The List of Wastes (England) Regulations 2005.*
[19] Department for Environment, Food and Rural Affairs (June 2013), *National Policy Statement for Hazardous Waste: A framework document for planning decisions on nationally significant hazardous waste infrastructure.*
[20] This is the capacity threshold at which the construction of new hazardous waste landfill disposal capacity becomes nationally significant.
[21] See http://www.legislation.gov.uk/ukpga/2008/29/introduction (accessed 17/09/2013).

## 4.5 Hazardous waste management infrastructure

4.5.1 In 2011, a total of 4,193,218 tonnes of hazardous waste was sent for treatment/ disposal in England of which 910,640 tonnes was landfilled (i.e. 22%). Of this total, 733,716 tonnes (i.e. 81%) comprised construction and demolition waste (including asbestos and excavated soils from contaminated sites). Environment Agency hazardous waste data for England and Wales for the period 2006 to 2011 is shown in Table 4.

4.5.2 The List of Wastes (England) Regulations 2005 includes Chapter 17 'Construction and Demolition Waste (including excavated soils from contaminated sites)'. The nature of the Proposed Scheme suggests that the majority of hazardous waste for disposal will be construction and demolition waste.

Table 4: Construction and demolition waste (including excavated soils from contaminated sites) to hazardous landfill for England and Wales[22]

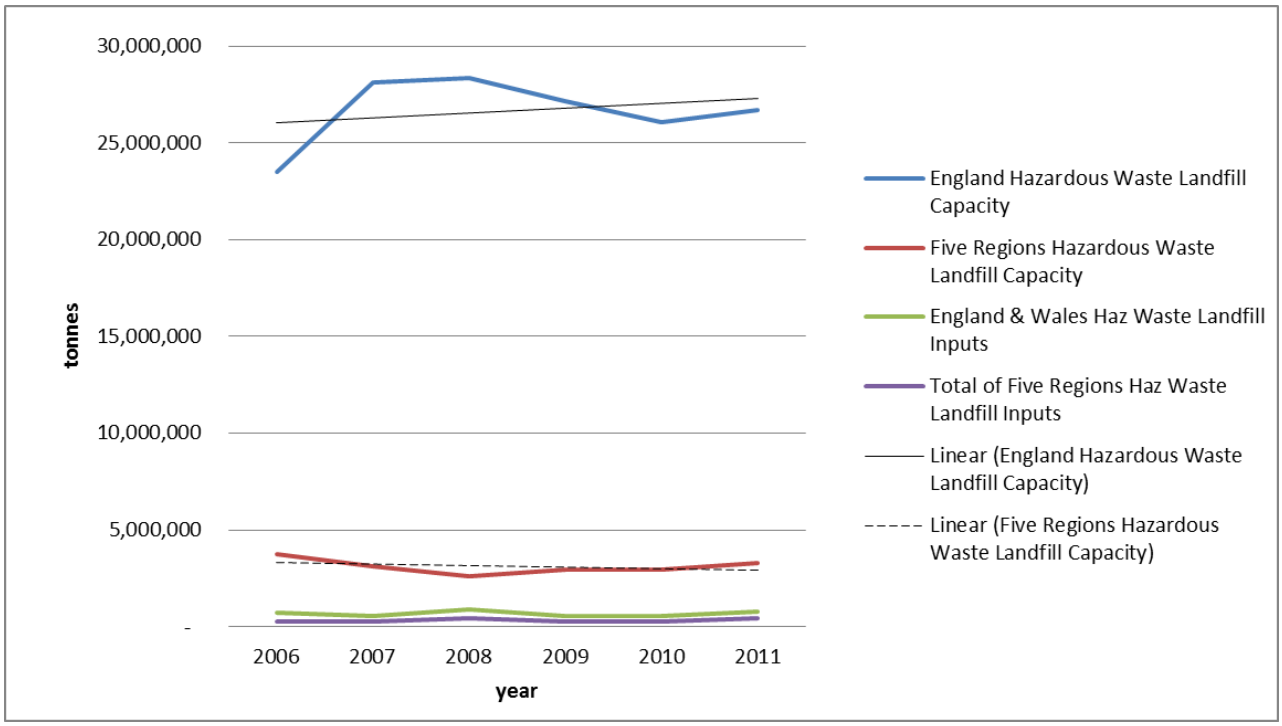
| Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|
| Tonnes | 643,989 | 642,303 | 771,599 | 372,801 | 328,395 | 733,716 |
| As % of total hazardous waste to landfill | 88% | 114%[23] | 84% | 68% | 62% | 81% |

4.5.3 There are a number of off-site soil treatment centres in England for the treatment and reuse of contaminated soils. There are also on-site treatment technologies available depending on the nature of the soil contamination.

4.5.4 Latest available data published by the Environment Agency[24] shows a slightly upward trend of hazardous waste landfill capacity in England (indicated by the linear trend line) with about 24 million tonnes in 2006 increasing to almost 27 million tonnes in 2011, as shown in Figure 3.

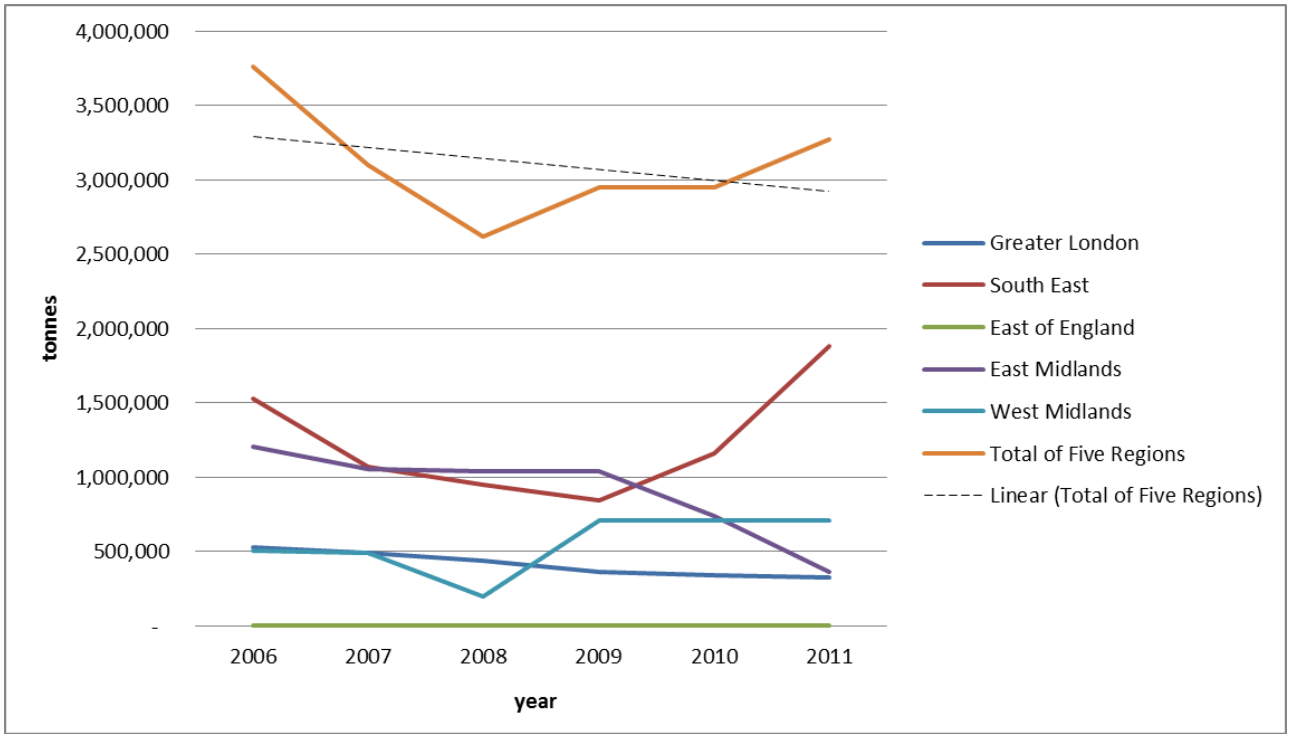
[22] Environment Agency Waste Data Tables. http://www.environment-agency.gov.uk/research/library/data/142773.aspx (accessed 26/06/2013).
[23] Assumes difference sent to non-hazardous SNRHW landfill – see Section 2.4.
[24] Environment Agency; Waste Data Tables, England and Wales – Landfill Capacity Trends 2006-2011; http://www.environment-agency.gov.uk/research/library/data/142773.aspx (accessed 25/07/2013).

Figure 3: Hazardous landfill capacity and inputs in England/five regions (2006 to 2011)




4.5.5 The hazardous waste landfill capacity data for the combined five regions indicates an overall slight downward trend (indicated by the linear trend line) from almost four million tonnes in 2006 to just over three million tonnes in 2011. However, since 2008 there has been a slight upward trend in available annual capacity as indicated by the linear trend line (see Figure 4). There has been a reduction in capacity in the East Midlands but an increase in capacity in the South East and West Midlands. There is no hazardous waste landfill capacity in the East of England region.

Figure 4: Hazardous landfill capacity trend of the five regions



## 4.6 Hazardous landfill significance criteria

4.6.1 The significance criteria in Table 5 have been developed for hazardous waste landfill as part of the Scope and Methodology Report Addendum, to which this technical note is appended. They are relevant for hazardous waste, which will arise from the construction of the Proposed Scheme associated with the excavation of contaminated land.

Table 5: Hazardous landfill significance criteria

| Degree of significance | Hazardous landfill criteria |
|---|---|
| Major adverse | Net increase in waste arisings relative to the future baseline leading to a severe national and regional-scale reduction in hazardous waste landfill void space capacity. Need for additional large-scale hazardous waste disposal capacity of greater than 100,000 tonnes per annum[25]. Effect may be judged to be of importance in the regional planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in the decision-making process. |
| Moderate adverse | Net increase in waste arisings relative to the future baseline leading to regional-scale reduction in hazardous waste landfill void space capacity or need for additional medium-scale waste hazardous waste disposal capacity of between 20,000 to 100,000 tonnes per annum. Effect may be judged to be important in the local planning context, e.g. where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required. |
| Minor adverse | Net increase in waste arisings relative to the future baseline leading to local-scale reduction in hazardous waste landfill void space capacity or need for additional small scale hazardous waste disposal capacity of up 20,000 tonnes per annum. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project. |
| Negligible | No significant increase in waste arisings relative to the future baseline or reduction in landfill void space capacity. No appreciable adverse or beneficial effects. |
| Beneficial | Net reduction in hazardous waste arisings and diversion of waste from landfill relative to the future baseline resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of hazardous waste treatment and disposal infrastructure. |

4.6.2 The threshold value of 100,000 tonnes per annum has been chosen for major adverse environmental effects based on the nationally significant hazardous waste infrastructure limit given in the NPS for hazardous waste.

4.6.3 The disposal of 100,000 tonnes of hazardous waste would represent about 0.4% of the hazardous landfill capacity in England, and about 3% of the combined five regions, based on the most recently available data for 2011 from the Environment Agency[26].

4.6.4 The threshold values for minor and moderate adverse environmental effects have been based on professional judgement. These are extrapolations of the threshold value for major adverse environmental effects based on an incremental decrease of the total hazardous waste quantity to be disposed of using a reduction factor of five to define the upper threshold value for minor environmental effects of 20,000 tonnes per annum. The moderate adverse threshold value is 20,000 to 100,000 tonnes per annum.

4.6.5 Landfill for non-hazardous waste may be used to dispose of stable non-reactive hazardous waste (SNRHW) providing such disposal does not occur in the same landfill cell as non-hazardous waste. SNRHW must exhibit leaching behaviour equivalent to non-hazardous waste. In practice, this restricts the disposal of hazardous wastes to non-hazardous landfill to material such as asbestos waste (e.g. asbestos cement

[25] Figure is threshold value given in s.30 Planning Act 2008 and referenced in National Policy Statement for Hazardous Waste.
[26] Environment Agency; Waste Data Tables, England and Wales – Landfill Capacity Trends 2000-2011; http://www.environment-agency.gov.uk/research/library/data/142773.aspx (accessed 25/07/2013).

board). Environment Agency landfill data does not quantify the amounts of hazardous waste sent to non-hazardous SNRHW landfill but does state it is usually a small part of the overall capacity of the site.

4.6.6 The Proposed Scheme would be constructed over a period of nine years (i.e. 2017 to 2025) starting initially with enabling works followed by the earthworks such as tunnelling etc. Any hazardous waste generated by the Proposed Scheme would not occur all in a single year but extend over at least a two year period, which will reduce the pressure on hazardous landfill capacity.

# Appendix A: EIA Guidance

1.1.1 Extract taken from Department for Communities and Local Government, Circular 02/99: Environmental impact assessment: 'Annex A: Indicative Thresholds and Criteria for Identification of Schedule 2 Development Requiring EIA.'

## Installations for the disposal of non-hazardous waste

1.1.2 **A36**. The likelihood of significant effects will generally depend on the scale of the development and the nature of the potential impact in terms of discharges, emissions or odour. For installations (including landfill sites) for the deposit, recovery and/or disposal of household, industrial and/or commercial wastes (as defined by the Controlled Waste Regulations 1992) EIA is more likely to be required where new capacity is created to hold more than 50,000 tonnes per annum, or to hold waste on a site of 10 hectares or more. Sites taking smaller quantities of these wastes, sites seeking only to accept inert wastes (demolition rubble etc.) or Civic Amenity sites, are unlikely to require EIA.

# HS2 London-West Midlands

# Waste and material resources

# Technical note – Waste forecast and assessment methodology

## A report to HS2 Ltd by Arup/URS

# Contents

# 1 Introduction

## 1.1 General

1.1.1 This technical note sets out the detailed methodology for the forecasting of waste arisings and the route-wide assessment of the likely significant environmental effects associated with the off-site disposal to landfill of solid waste that will be generated by construction and operation the Proposed Scheme.

1.1.2 The scope of this technical note covers:

- waste that will be generated by excavation, demolition and construction activities undertaken during the proposed construction period;
- waste that will be generated by occupants of worker accommodation sites during the proposed construction period; and
- operation of the Proposed Scheme.

# 2 Waste forecast

## 2.1 General

2.1.1 This section sets out how the quantities of waste likely to be generated during the construction and operational phases of the Proposed Scheme will be forecast.

2.1.2 All waste arisings will be reported in tonnes rounded to the nearest whole number.

## 2.2 Excavated material

2.2.1 Excavated material will be generated to accommodate cuttings, foundation construction sites, drainage excavations and through tunnelling operations etc.

2.2.2 The volume of excavated material to be generated will be determined and converted to mass using a density conversion factor of 2.058tonnes/m3.[1]

2.2.3 The quantity of hazardous waste (i.e. unacceptable material Class U2)[2] that will be generated as a result of the excavation of contaminated soils, and which cannot be remediated and reused on- or off-site, will be determined. It will be assumed that all hazardous waste generated by the excavation of contaminated soils will require off-site disposal to a hazardous waste landfill.

2.2.4 Quantities of both excavated material to be reused and surplus excavated material for disposal will be presented in Volume 5: Appendix WM-001-000 (Annex I). The likely significant environmental effects associated with the off-site disposal to landfill of surplus excavated material will be assessed.

[1] In line with evidence-based research undertaken to inform value of the density conversion factor.
[2] Department for Transport; *Highways Agency, Manual of Contract Documents for Highway Works, Volume 1 – Specification for Highway Works, Series 600 Earthworks*; http://www.dft.gov.uk/ha/standards/mchw/vol1/; Accessed 26 June 2013.

## 2.3 Demolition waste

2.3.1 Demolition waste will be generated by the removal of existing buildings, structures and infrastructure elements such as bridges, roads, railways and utilities.

2.3.2 The quantity of waste (in tonnes) that will be generated by specified demolition activities within each CFA will be forecast using the WRAP (Waste and Resources Action Programme) 'Demolition bill of quantities estimator' that uses the basic dimensions and typology of buildings to forecast waste arisings.

## 2.4 Construction waste

2.4.1 Waste will be generated by the construction of track, buildings and other structures, including stations, maintenance sheds and stabling yards.

2.4.2 The quantity of waste (in tonnes) that will be generated by specified construction activities within each CFA will be forecast using a waste generation rate of 26.4tonnes/£100,000 of construction value. This waste generation rate has been derived from industry-wide benchmark performance data procured from the Building Research Establishment.[3]

## 2.5 Worker accommodation site waste

2.5.1 The quantity of waste (in tonnes) that will be generated at worker accommodation sites within each CFA will be forecast using a waste generation rate of 0.031tonnes/person/month according to the number of workers to be accommodated and the duration of occupation. This waste generation rate was derived from the average annual household waste generation in the UK of 466kg/person/year in 2009/10 and has been adjusted assuming an average working week of five and a half days.[4]

## 2.6 Operational waste

2.6.1 All operational waste forecasts for the Proposed Scheme will be on an annual basis and an assumption of maximum capacity in the first year of operation (2026).

2.6.2 The scope of operational waste forecasting covers:

- railway station and train waste;
- rolling stock maintenance waste;
- track maintenance waste; and
- ancillary infrastructure waste (relating to waste arising from depots, signalling locations and operations and maintenance sites). Waste from 'maintenance sites' in this context excludes the aforementioned rolling stock maintenance waste and track maintenance waste.

2.6.3 Individual waste forecasts for each of the above listed categories will be combined to provide an overall forecast of operational waste arisings.

[3] Building Research Establishment Ltd (2013), *Construction Waste Benchmarks for Railway Projects*.
[4] Department for Environment, Food and Rural Affairs; *Waste and Recycling Statistics*; https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs/series/waste-and-recycling-statistics; Accessed 25 February 2013.

## Railway station and train waste

2.6.4 Railway station and train waste refers to waste that will arise at each station and includes:

- waste from individual functions within stations such as retail units, food and beverage outlets etc.; and
- waste removed from trains, which will be the case at terminating stations only.

2.6.5 The waste generation rate used to forecast railway station and train waste has been formulated on the basis of actual annual waste data (including both railway station and train waste) from Network Rail and the numbers of people using stations from the Office of Rail Regulation. The number of people using stations has been provided on the basis of the number of entries and exits through ticket barriers.

2.6.6 The annual quantity of waste (in tonnes) that will be generated in railway stations and on trains will be forecasted using a waste generation rate of 0.085kg per station entry and exit.

2.6.7 Based on the Network Rail target to divert 60% of operational waste from landfill by 2014:

- 0.051kg of waste will be diverted from landfill per station entry and exit; and
- 0.034kg of waste will be landfilled per station entry and exit.

2.6.8 This forecasting methodology does not make any distinction between station types; i.e. between terminating stations that include train waste or non-terminating stations that do not include train waste. This is because the majority of waste produced will be station waste (regardless of the type of station) and so there is no consistently discernible difference between the two station types.

## Rolling stock maintenance waste

2.6.9 Rolling stock maintenance waste is that which will be generated by the relevant train operating company (or its fleet maintenance contractor) and thus reported separately to ancillary infrastructure waste and track maintenance waste that will be generated by Network Rail.

2.6.10 In the absence of actual data from existing train operating companies, the waste generation rate that will be used to forecast rolling stock maintenance waste has been adopted from British Standard (BS) 5906:2005 Waste Management in Buildings – Code of Practice. This relates to a waste generation rate of 5litres/m2/week for an industrial unit, which has been converted to an annual tonnage rate using a waste density conversion factor of 1.16tonnes/$m^3$.[5]

2.6.11 The annual quantity of rolling stock maintenance waste (in tonnes) that will be generated will be forecast and reported according to the CFA in which it will arise. This will be done using a waste generation rate of 0.3tonnes/$m^2$/year applied to the gross floor area of each rolling stock depot within a CFA.

[5] Based on an average of waste density conversion factors for heavy scrap metal (1.78tonnes/$m^3$), light scrap metal (0.74tonnes/$m^3$) and oils, tars and asphalts (0.95t/$m^3$); taken from Tchobanoglous, G., Theisen, H., Vigil, S.A. (1993), *Integrated Solid Waste Management. Engineering Principles and Management Issues*. McGraw-Hill.

2.6.12 Where a rolling stock maintenance depot forms part of a larger depot (e.g. that also incorporates ancillary infrastructure and track maintenance facilities), the proportion of floor space provided solely for rolling stock maintenance will be used in the waste generation forecast.

2.6.13 A landfill diversion rate of 80% will apply to rolling stock maintenance waste. This figure has been assumed on the basis of professional judgement taking into account the following information:

- Network Rail's target to divert 60% of operational waste from landfill by 2014 (as applied to ancillary infrastructure waste for this assessment);
- Network Rail's average landfill diversion rate (85%) for track maintenance wastes; and
- generic landfill diversion data published by Alstom[6] and Bombardier[7] (both of which have significant business activities in rolling stock maintenance) ranging from 78% to 90%.

## Track maintenance waste

2.6.14 Track maintenance waste is that which will be generated and reported separately to ancillary infrastructure waste and rolling stock maintenance waste.

2.6.15 The waste generation rate that will be used to forecast track maintenance waste has been formulated on the basis of data provided by Network Rail.

2.6.16 The annual quantity of track maintenance waste (in tonnes) that will be generated will be forecast according to the total length of track within each CFA using a waste generation rate of 8.23tonnes/km/year.

2.6.17 For any track sections with two or more lines, the distance vector will be scaled up according to the number of lines (e.g. doubled for a twin track, trebled for three lines etc.). This is because the waste generation rate to be used is based on the length of a composite track comprising of two rails, sleepers, clips and ballast etc.

2.6.18 Based on Network's Rails average landfill diversion rate of 85% across a range of material types for track maintenance waste:

- 7.00tonnes/km/year of waste will be diverted from landfill; and
- 1.23tonnes/km/year of waste will be landfilled.

## Ancillary infrastructure waste

2.6.19 Ancillary infrastructure waste refers to waste that will arise from depots, signalling locations, operations and maintenance sites excluding track maintenance waste and rolling stock maintenance waste (according to the scope of the waste generation rate used).

[6] Alstom has a target to achieve 80% landfill diversion of total waste generated by 2015, against which it had achieved 78% by 2011. See – Alstom; http://www.alstom.com/Sustainability/Our-commitment/Environment/Waste-Management/; Accessed 7 July 2013.
[7] Data reported by Bombardier's Transportation Group indicates a landfill diversion performance of 84% in 2010, and 90% in both 2011 and 2012. See – Bombardier; *2012 Performance Data Summary*; http://csr.bombardier.com/en/csr-approach/2012-performance-data-summary; Accessed 7 July 2013.

2.6.20 The waste generation rate that will be used to forecast ancillary infrastructure waste has been formulated on the basis of data provided by Network Rail.

2.6.21 The annual quantity of ancillary infrastructure waste (in tonnes) that will be generated will be forecast according to the total length of track within each CFA using a waste generation rate of 0.692tonnes/km/year.

2.6.22 For any sections with two or more lines, the distance vector will be scaled up according to the number of lines (e.g. doubled for a twin track, trebled for three lines etc.). This is because the waste generation rate to be used is based on the length of a composite track comprising of two rails, sleepers, clips and ballast etc.

2.6.23 Based on the Network Rail target to divert 60% of operational waste from landfill by 2014:

- 0.415tonnes/km/year of waste will be diverted from landfill; and
- 0.277tonnes/km/year of waste will be landfilled.

# 3 Assessment methodology

## 3.1 Background

3.1.1 There is no recognised methodology or waste significance criteria available to assess the likely significant environmental effects associated with the off-site disposal to landfill of solid waste that will be generated by construction and operation of the Proposed Scheme.

3.1.2 The assessment methodology that will be used is based on professional judgement and experience with the application of EIA to rail-related and other large scale transport infrastructure projects.

3.1.3 The assessment will consider the types and quantities of waste that will be generated during construction and operation and the severity of the likely significant environmental effects that may arise from the quantity of waste requiring off-site disposal to landfill (this being the least preferred waste management option).

3.1.4 This approach takes into account the overall quantity of waste likely to be generated, the types and quantities of waste likely to require off-site disposal to landfill and the projected availability of landfill disposal capacity in the defined study area.

## 3.2 Legislation and guidance

3.2.1 Assessment and mitigation of the likely significant environmental effects of waste generation will be considered with respect to relevant legislation, policy and guidance governing the management of waste in England. A summary of applicable legislation, policy and guidance is provided further in sections 3.2.2 to 3.2.12.

### Legislation

3.2.2 The key items of relevant legislation are as follows:

- The Waste (England and Wales) Regulations 2011 SI No. 988 (as amended), which transpose the provisions of the 'EU Waste Framework Directive' (2008/98/EC)[8] into England and Wales.
- The Controlled Waste (England and Wales) Regulations 2012 SI No. 811 (as amended, which sets out the definition of controlled waste to which waste management regulatory controls apply.
- The Environmental Permitting (England and Wales) Regulations 2010 SI No. 675 (as amended), which provide a consolidated system for permitting of waste operations (amongst other activities not relevant in this context).
- The Hazardous Waste (England and Wales) Regulations 2005 SI. No 894 (as amended), which set out the regime for the control and tracking of the movement of hazardous waste.
- The List of Wastes (England) Regulations 2005 SI No. 895 (as amended), which provides for the classification of wastes and determination of hazardous wastes.

[8] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on Waste and Repealing Certain Directives.

- The Site Waste Management Plans Regulations 2008 SI No. 314, which require the preparation of a site waste management plan (SWMP) for any construction project with an estimated capital cost of over £300,000. The purpose of the SWMP is to identify opportunities to design out waste; identify the types and quantities of waste likely to be produced during construction; identify opportunities for sustainable management of the waste identified; and to monitor and report on the actual management of these wastes throughout the construction period.

- The Site Waste Management Plans Regulations 2008 SI No. 314 are likely to be repealed as a result of consultations proposed by the Defra Red Tape Challenge.[9] However, HS2 Ltd will apply an integrated approach to the design of the Proposed Scheme aiming to maximise the beneficial reuse of materials where possible and minimise the generation of waste. This will be facilitated through the implementation of the Code of Construction Practice for the Proposed Scheme.

## Policy

3.2.3 The Government Review of Waste Policy in England 2011[10] sets out the Government's long-term strategy for the prevention and management of waste in England. It follows the waste hierarchy approach set out in the EU Waste Framework Directive.

3.2.4 Planning Policy Statement 10: Planning for Sustainable Waste Management,[11] as exempted within the NPPF, sets out Government policy on waste planning which is of relevance to the management strategy for waste generated during the construction and operation of the Proposed Scheme.

3.2.5 Regional and local policy, such as the London Plan: Spatial Development Strategy for London,[12] sets out strategic planning policies for the management of waste generated in Greater London and elsewhere along the route of the Proposed Scheme. Specifically, these policies seek to minimise the amount of waste generated, increase the reuse and recycling of waste and reduce waste to landfill.

## Guidance

3.2.6 Relevant guidance includes The Definition of Waste: Development Industry Code of Practice[13] and the Waste & Resources Action Programme (WRAP) guidance and tools developed to achieve better resource efficiency in construction projects. This includes designing out waste tools such as the Designing out Waste Tool for Civil Engineering and the Net Waste Tool[14].

[9] Department for Environment, Food and Rural Affairs; *Red Tape Challenge: Environment Theme Proposals*; https://www.gov.uk/government/publications/red-tape-challenge-environment-theme-proposals; Accessed 7 July 2013.
[10] Department for Environment, Food and Rural Affiars; *Government Review of Waste Policy in England*; https://www.gov.uk/government/publications/government-review-of-waste-policy-in-england-2011; Accessed 7 July 2013.
[11] Department for Communities and Local Government; *Planning for Sustainable Waste Management: Planning Policy Statement 10;* *https://www.gov.uk/government/publications/planning-for-sustainable-waste-management-planning-policy-statement-10*; Accessed 7 July 2013.
[12] Greater London Authority; *The London Plan*; http://www.london.gov.uk/priorities/planning/london-plan; Accessed 7 July 2013.
[13] Contaminated Land: Applications in Real Environments; Definition of Waste: Development Industry Code of Practice; http://www.claire.co.uk/index.php?option=com_content&view=article&id=210&Itemid=82; Accessed 7 July 2013.
[14] Waste and Resources Action Programme; Construction; http://www.wrap.org.uk/category/sector/construction ; Accessed 7 July 2013.

## 3.3 Significance criteria

3.3.1 There are no recognised significance criteria against which the likely significant environmental effects associated with the off-site disposal to landfill of solid waste from construction and operation can be assessed.

3.3.2 Significance criteria for the assessment have been derived based on professional judgement and as previously applied to large-scale infrastructure projects. Significance criteria take into account the change in waste arisings overall as a result of the Proposed Scheme and the severity of the likely significant environmental effects that may arise from the quantity of waste requiring off-site disposal to landfill.

3.3.3 A technical note, Rationale for landfill significance criteria setting out the significance criteria to be used has been developed and should be read in conjunction with this technical note (see Annex J of the SMR addendum).

## 3.4 Construction effects

3.4.1 The basis of the assessment of the likely significant environmental effects associated with the off-site disposal to landfill of solid waste from construction will be the forecast of the quantity of construction, demolition and excavation waste to be generated during the proposed construction period. The forecast will also include waste generation associated with the worker accommodation sites.

3.4.2 The methodology for forecasting construction, demolition and excavation waste, as well as waste generation associated with worker accommodation sites, is outlined in Section 2 of this technical note.

3.4.3 In quantifying waste arisings to landfill, evidence-based assumptions will be applied for construction, demolition and worker accommodation site waste as follows:

- construction waste – landfill diversion rate of 90%;
- demolition waste – landfill diversion rate of 90%; and
- worker accommodation site – landfill diversion rate of 50%.

3.4.4 The quantity of excavated material requiring disposal (surplus excavated material) will be based on the cut and fill balance for the Proposed Scheme.

3.4.5 It will be assumed that 100% of any hazardous waste arisings will require off-site disposal to a hazardous waste landfill (i.e. zero landfill diversion rate).

3.4.6 Following this, the total quantity of waste requiring off-site disposal to landfill during the proposed construction period (2017 to 2025) will be assessed in relation to the significance criteria to be used.

## 3.5 Operational effects

3.5.1 The assessment of operational effects will rely on the total annual quantity of waste forecast to be generated during the first full year of operation of the Proposed Scheme (i.e. 2026). The operational waste forecast will be undertaken as described in Section 2 of this technical note.

3.5.2 In quantifying waste arisings to landfill, assumptions will be applied as set out within Section 2.6 of this technical note. These assumptions will be:

- railway station and train waste – landfill diversion rate of 60%;
- ancillary infrastructure waste – landfill diversion rate of 60%;
- track maintenance waste – landfill diversion rate of 85%; and
- rolling stock maintenance waste – landfill diversion rate of 80%.

3.5.3 Following this, the total quantity of waste requiring off-site disposal to landfill during the year of operation (2026) will be assessed in relation to the significance criteria to be used for non-hazardous waste.

## 3.6 Cumulative effects

3.6.1 The assessment of cumulative effects with respect to waste and material resources will focus on inter-project effects, i.e. effects that will arise as a result of interactions between the Proposed Scheme and other projects.

3.6.2 Such interactions in this context will be the combined quantity of waste requiring off-site disposal to landfill as a result of the construction and / or operation of the Proposed Scheme and other committed developments (i.e. other reasonably foreseeable developments that are likely to be under construction or will be completed at the same time as the Proposed Scheme).

3.6.3 The total quantity of waste likely to be generated by other committed developments (including that which will require subsequent off-site disposal to landfill) will be assessed qualitatively according to professional judgement based on the known type and extent of development. This is because:

- forecast waste arisings and landfill disposal assumptions may not have been published for other committed developments; and
- published forecast waste arisings and landfill disposal assumptions may not have been developed on the same basis as for the Proposed Scheme and hence may not be directly comparable.

## 3.7 Off-route effects

3.7.1 Where relevant, this technical note will also apply to the assessment of off-route effects that will be dealt with in Volume 4 of the formal Environmental Statement.

## 3.8 Climate change impacts

3.8.1 Whilst there are some potential climate change impacts on waste and material resources (detailed in Scope and Methodology Report Addendum, Volume 5: Appendix CT-001-000/2), these are not considered to have any significant direct impact and hence will not be considered further within the assessment.

## 3.9 Mitigation, enhancement and off-setting

3.9.1 Mitigation of construction and operation effects will be considered in line with key principles of waste and material resources management including the waste

hierarchy, proximity principle and product (or development) lifecycle. Mitigation will also have regard to relevant legislation, policy and guidance.

3.9.2 Residual environmental effects will be identified, subsequent to the application of any mitigation measures.

# Annex K: Water resources and flood risk– technical notes

1.1.1 The following technical notes are appended to this document:

- Surface water quality assessment
- Ground water assessment method
- Spillage risk assessment

# HS2 London-West Midlands

# Water resources and flood risk

# Technical note – Surface water quality assessment

## A report to HS2 Ltd by Arup/URS

# Contents

# 1 Introduction

1.1.1 This technical note has been prepared as guidance for the assessment of the effects of the project on the quality of surface waters. It should be read in conjunction with the Scope and Methodology Report (SMR see Volume 5; Appendix CT-001-000/1). Mitigation of these effects and reporting of residual effects should be carried out as stated in the SMR.

1.1.2 The note is intended as a guide to ensure a consistent approach across the project, not an exhaustive and prescriptive methodology.

1.1.3 This note should not be used to assess the following:

- effects from construction of the project (see code of construction practice);
- effects on groundwater (see Water resources and flood risk technical note – groundwater assessment method in Annex K of the SMR addendum); and
- effects from accidental spillages (see Water resources and flood risk technical note – Spillage risk assessment in Annex K of the SMR addendum).

# 2 Baseline assessment

## 2.1 Baseline definition

2.1.1 Where there is a defined impact pathway for the operation of the railway to have an effect on the quality of surface water receptors, the baseline condition of those water body receptors shall be defined.

2.1.2 The baseline assessment for each water body shall be recorded using the Water Framework Directive[1] (WFD) status classification system for surface waters covering watercourses, lakes and artificial or heavily modified water bodies.

2.1.3 Within the context of the water resources and flood risk topic, the following elements of a water body's WFD status will be considered within the surface water quality baseline:

- physico-chemical and specific pollutants components of the watercourse's 'ecological status'; and,
- where appropriate, the priority substances components of the watercourse's 'surface water chemical status'.

2.1.4 Other WFD elements, such as biological quality, are covered by other technical disciplines.

2.1.5 The baseline assessment will also consider other potential quality elements not specifically used in determining WFD status where a scheme impact may affect this element e.g. suspended solids, or nitrate concentrations for fluvial systems in Nitrate Vulnerable Zones.

[1] European Commission (EC), 2000, *Water Framework Directive (2000/60/EC)*, EC.

2.1.6 A report assessing the extent to which the Proposed Scheme complies with the Water Framework Directive will be included in the Environmental Statement.

## 2.2 Data from the Environment Agency and others

2.2.1 The assessment of the baseline conditions will generally utilise water quality data received from the Environment Agency, water companies or local authorities. This data is expected to be sufficient for the vast majority of locations where a baseline assessment is required. All such received data should meet the criteria set out in paragraph 2.2.3.

2.2.2 The baseline assessment shall be recorded using the existing WFD status class of the watercourse.

2.2.3 Where a baseline assessment is required, but no data is available at the point of impact, the next downstream location where data is available will be used. The data is considered appropriate for use in an assessment if:

- the location is within 5km;
- there is no significant change in land use, which could result in the introduction of different diffuse pollutants, between the impact point and sample point; and
- there is no discharge entering the downstream length of the watercourse that results in, or has the potential to effect a change in, the physico-chemical or specific pollutant standards of a watercourse's WFD ecological status or the watercourse's WFD chemical status.

2.2.4 If no data is available from a downstream location, the Environment Agencywill be approached, as they may hold unpublished data that would be appropriate.

2.2.5 A potential impact source resulting in water quality effects could be:

- pollution from a new station;
- pollution from a new depot
- pollution from other railway infrastructure;
- pollution from a public road; or
- physical changes to water body morphology (e.g. channel diversion or river crossings).

2.2.6 If a potential impact pathway is identified from any of these impact sources to a receptor where no baseline data (that meets the criteria in this section) is available then targeted water sampling should be considered.

## 2.3 Water sampling protocol

2.3.1 The Environment Agency should be consulted prior to any water sampling, because:

- they may be able to carry out the sampling as part of their own work; or

- if they cannot carry out the work, the frequency and method of sampling should be discussed.

2.3.2 At least four samples should be obtained, at least one month apart, over a six month period. Analysis of the samples should be carried out at a certified laboratory.

# 3 Scope of impact assessment

3.1.1 The method in this Section should be used to assess the effects on surface water quality for all locations on the project with the exception of:

- roads where the annual average daily traffic of Heavy Goods Vehicles is forecast to exceed 500, where the HAWRAT method in Design Manual for Roads and Bridges 11.3.10 (HD45)[2] should be used; and
- locations where all the drainage will be discharged to a foul sewer.

3.1.2 When assessing the effects on the quality of surface watercourses, the following will be used: details of the receiving water course and an estimate, based on a combination of expert judgement and analysis, for the quantity of pollution that could be released during routine operations. Estimates will be conservative and assume little or no dispersion.

3.1.3 Where flow information for a watercourse is not available from a suitable monitoring location, flow estimates will be derived for that location using Low Flows[3] software or an appropriate alternative. Estimates will be conservative, assuming no or low dispersion.

3.1.4 Similar to highway drainage, release quantities should be derived from typical annual loading measured in track drainage elsewhere (if these have been quantified).

3.1.5 The method shall consider the effects of the operation of the railway, including minor maintenance such as treatment with herbicides or pesticides, and treatment with de-icing materials. These are addressed in the draft Operation and Maintenance Plan for Water Resources and Flood Risk (refer to Volume 5: Appendix WR-001-000).

[2] DMRB (2006), Volume 11 Section 3 Part 10: HD45: Road Drainage and the Water Environment.
[3] Gustard, A et al, Low flow estimation in the UK: Institute of Hydrology Report no 108 (1992).

# HS2 London-West Midlands

# Water resources and flood risk

# Technical note – Groundwater assessment method

## A report to HS2 Ltd by Arup/URS

# Contents

# 1 Introduction

1.1.1 This technical note has been prepared to provide guidance for in the assessment of the effects of the project on groundwater quantity and quality. It should be read in conjunction with the Scope and Methodology Report (SMR) (see Volume 5:Appendix CT-001-000/1)

1.1.2 The note is intended as a guide to ensure a consistent approach across the project, not an exhaustive and prescriptive methodology

1.1.3 This note should not be used to assess the following:

- effects from construction of the project (see draft code of construction practice (CoCP) - Volume 5; Appendix CT-003-000);
- effects on surface water (see Water resources and flood risk technical note – surface water assessment - see Annex K of the SMR addendum); or
- effects from accidental spillages (see Water resources and flood risk technical note – spillage risk assessment see Annex K of the SMR addendum).

1.1.4 This technical note is set out in four sections covering baseline, impact assessment, mitigation and residual effects.

1.1.5 There is overlap between groundwater and other topics including surface water, flood risk, ecology, land quality and geotechnics. These are referred to as necessary in the following sections to provide guidance on areas of responsibility.

# 2 Baseline

## 2.1 Baseline data

2.1.1 Where recent (since 2010) groundwater quality data is available, this can be used to define baseline groundwater quality. In the absence of such data, the status of groundwater bodies can be used, if available.

2.1.2 Water quality standards (WQS) are used to indicate baseline groundwater quality. Two forms of WQS are available: drinking water standards (DWS) and environmental quality standards (EQS). DWS are defined to protect human health (i.e. are suitable for potable supply); whereas, EQS are defined to protect sensitive aquatic ecology from any surface water receiving groundwater via baseflow. The appropriate WQS should be chosen based upon site conditions; where both are applicable, the more stringent WQSs should be applied. Reference should be made to the conditions of each WQS, for instance, whether the standard applies to an annual average concentration or the maximum admissible concentration, and a consistent and appropriate approach should be taken, based upon WQS conditions and data availability.

2.1.3 Groundwater level data should extend back as far as possible so that seasonal and long term fluctuations can be identified. Peak wet years and extended drought periods should be used to determine maximum and minimum groundwater ranges where possible. Future variations as a result of climate change are to be considered, in

addition to these historical variations, using the process set out in the ES (refer to SMR Addendum Section17, Water resources and flood risk assessment).

2.1.4 Project specific groundwater data should be collected if the opportunity arises in sensitive areas and where boreholes are to be drilled for geotechnical, design or land quality reasons.

## 2.2 Baseline conditions

2.2.1 The base case to be adopted will depend on data availability but ideally should extend to 2011 for variables such as water quality and groundwater levels.

2.2.2 The cut off date for data such as Environment Agency levels and licensed abstractions should be clearly stated.

2.2.3 Aquifer parameter data and information such as groundwater/surface water interactions is unlikely to be time sensitive so all published data may be relevant.

2.2.4 The main mapping scale to be used is 1:50,000, with detail at 1:10,000 in selected areas if needed.

2.2.5 Baseline contamination data will be collected by the land quality teams. The geology baseline description will be based on that prepared by the land quality teams to ensure consistency. Baseline ecology and identification of groundwater dependent ecosystems should be collected by the ecology teams.

# 3 Impact assessment

## 3.1 Groundwater quantity and flow

3.1.1 Dewatering and mounding effects will be assessed qualitatively unless the design assumption of 1m below track bed can be used to quantify effects in combination with accepted hydrogeological solutions, for example Theis well theory or Darcy's Law.

3.1.2 Greater emphasis and attempts to quantify impacts should be focussed on areas of high risk.

3.1.3 Dewatering calculations will give an indication of magnitude of impact based on selected hydraulic conditions. The aim is to estimate the potential effect and thus identify mitigation rather than make accurate predictions. Once site specific data is available the estimates may change.

3.1.4 Dewatering impacts (flow rates and drawdown) as a result of temporary shafts or portal dewatering will be quantified for the purpose of the EIA using site data where available or using data from existing groundwater models. In the absence of such data, 25 and 75 percentile hydraulic values from the British Geological Survey (BGS) Aquifer Properties Manual[1] should be used. To be conservative a higher permeability and lower storativity are recommended. Professional judgement may also be used.

3.1.5 Drawdowns will be based on measured groundwater levels where available, or on water strikes from borehole logs where applicable.

[1] BGS, 1997. The Aquifer Properties of Major Aquifers in England and Wales.

3.1.6 For shaft dewatering, if the highest groundwater level in the aquifer is below the base of the excavation at the time of casting, then it will be assumed that dewatering is not required.

3.1.7 Initial estimates of the flow rates required for dewatering shafts can be made using the Thiem and Sichardt equations. These equations apply to an idealised aquifer which is horizontal, confined above and below between impermeable formations, infinite in horizontal extent, of constant thickness and homogeneous and isotropic with respect to its hydrogeological parameters.

$$Q = \frac{2\pi kD(H-h)}{\ln(R_o / R_e)}$$ Thiem equation for confined conditions

$$R_o = C(H-h)\sqrt{k}$$ Sichardt formula

Where;

| | | |
|---|---|---|
| Q | = | flow rate (m3/d) |
| Qpp | = | flow rate adjusted for partial penetrating wells |
| k | = | permeability (m/d) |
| D | = | thickness of the confined aquifer (m) |
| d | = | depth well penetrates into aquifer (m) |
| H | = | initial piezometric level in the aquifer (m) |
| h | = | target drawdown level in the equivalent well (m) |
| Ro | = | radius of influence (m) |
| Re | = | effective radius of dewatering (m) (taken as 5m more than the shaft radius) |
| C | = | empirical calculation factor (assumed to be 3000 when k is in m/s) |

3.1.8 Where the dewatering wells are partially penetrating the flow rate will be adjusted to Qpp as follows:

$$Qpp = Q \times \frac{d}{D}$$

3.1.9 The equations represent steady state conditions and are therefore appropriate if dewatering is likely to occur over a number of months to a point where groundwater level changes stabilise. For shorter scale works, such as manholes, transient, non steady state methods will be applied, where appropriate, to determine the dewatering requirements.

3.1.10 Impacts of temporary dewatering in shallow aquifers where a steady state is not reached will be based on the Cooper Jacob equation for non-steady conditions where appropriate. The drawdown, s, at a distance, r, from the dewatering borehole assuming semi-confined aquifer conditions, is given by:

$$s = \frac{2.303Q\log 10(2.25kDt/(r^2S))}{4\pi kD}$$

Where

| | | |
|---|---|---|
| Q | = | flow rate from well (m3/s) |
| r | = | radius of interest (m) |
| s | = | drawdown (m) |
| S | = | specific yield of aquifer |

3.1.11 The impact of dewatering on Sites of Special Scientific Interest (SSSI) and other sensitive receptors will be estimated, where appropriate, using the following mathematical equations:

For plane flow (to a cutting): $$L_0 = \sqrt{\frac{12Tt}{S}}$$

Or radial flow: $$R_0 = \sqrt{\frac{2.25Tt}{S}}$$

Where

Lo or Ro are the distance of influence (m)

T is the transmissivity in (m2/d)

t is time (days)

S is the confined or unconfined storage depending on aquifer conditions

3.1.12 Further details are provided in the CIRIA Publication on Groundwater control – design and practice[2].

3.1.13 Dewatering impacts on surface watercourses and wetland hydrology (where these are known to be not perched) will be covered by the groundwater section, based on the baseline conditions provided by these topics.

3.1.14 The effects of dewatering or mounding may extend beyond the construction period and beyond the standard 1km groundwater assessment distance, and will be considered as exceptions, as set out in the SMR.

3.1.15 To quantify seepages into the tunnels, guidance such as the specification for tunnelling[3] can be used as appropriate.

## 3.2 Groundwater quality

3.2.1 Effects on groundwater quality will be assessed qualitatively. No significant effects during construction or operation are expected.

[2] Preene, M., Roberts, T.O.L., Powrie, W. and Dyer, M.R., (2000) Groundwater control – design and practice. CIRIA Publication C515.
[3] British Tunnelling Society and The Institution of Civil Engineers (2010) Specification for Tunnelling.

3.2.2 The groundwater section will assess pollution as a result of the groundwater pathway. The land quality topic will assess these effects as well as pathways other than groundwater and receptors other than groundwater.

## 3.3 Assessment methodology

3.3.1 The operational impacts will be assessed as per the SMR. The maximum and minimum groundwater condition may be more relevant in some circumstances.

3.3.2 The effects are to be assessed for receptors in the catchment or area under consideration; sources may fall within another catchment or area.

# 4 Mitigation

4.1.1 The general approach to mitigation is set out in Volume 1. Other avoidance and mitigation measures such as minimising dewatering, groundwater cut-off or re-routing of groundwater flows, water recirculation, re-injection and pollution control are discussed in the water resources and flood risk assessments. Note that water discharges during operation will be covered by permitting where necessary.

# 5 Reporting residual effects

5.1.1 The Environmental Statement will report the residual effects including mitigation measures.

5.1.2 Measures to mitigate residual effects may include compensation for derogation of licensed abstractions or other effects where monitoring confirms that the effect is significant.

# HS2 London-West Midlands

# Water resources and flood risk Technical note – Spillage risk assessment

## A report to HS2 Ltd by Arup/URS

# Contents

# 1 Introduction

1.1.1 This technical note has been prepared to give further guidance on the assessment of the risk of spillages and the possible environmental effects on the quality of the water environment. It should be read in conjunction with the Scope and Methodology Report (see Volume 5 Appendix CT-001-000/1).

1.1.2 The note is intended as a guide to ensure a consistent approach across the project, not an exhaustive or prescriptive methodology.

## 1.2 Scope of technical note

1.2.1 The note covers the assessment of the risks from accidents, spillages and the like during the operation of the railway.

1.2.2 The note covers all parts of the project constructed within the land required for the Proposed Scheme. It covers three main categories of asset as a source of spillage risk:

- the railway and associated infrastructure such as tunnels, embankments and viaducts;
- new or modified roads; and
- stations and depots.

1.2.3 The note does not cover the assessment of risks during the construction phase of the project.

1.2.4 The note does not cover the assessment of risks that occur during routine maintenance work. These are addressed in the draft Operation and Maintenance Plan for Water Resources and Flood Risk – (see Volume 5: Appendix WR-001-000).

1.2.5 The note does not cover the assessment of risks in locations where drainage is discharged to a foul sewer.

# 2 Baseline assessment

2.1.1 The baseline assessment should consider the risk of spillages and their consequences for the water environment from those parts of the lands required for the Proposed Scheme that are planned to be developed. These will include existing roads, existing stations, or those parts of existing stations due to be redeveloped, and other land required for the Proposed Scheme.

2.1.2 At many locations, for example existing agricultural land, the existing spillage risks are negligible. In other locations, for example existing roads, the baseline risks may exceed the future risks, due to improvement in the layout or pollution control measures in the roads.

# 3 Spillage risk methodology

## 3.1 Railway and associated infrastructure

3.1.1 The risk of pollution of the water environment from spillages from the operational railway and its maintenance is considered very low, as it is planned that only electric and totally sealed trains will use the route for the vast majority of the time. Spillages on the route are therefore only likely following derailments, collisions, or major on-board incidents, all of which are considered highly improbable.

3.1.2 Even if a spillage of a pollutant does occur, it will not necessarily lead to a pollution incident, as the pollutant may not reach a receiving water body, either because of prompt action by emergency personnel or as a result of pollution control measures, such as shut-off valves, balancing ponds, and silt traps, or because the pollutant is absorbed by ballast, soil or vegetation.

3.1.3 The risk at a discharge outfall will be a function of the generic risk, the length of the catchment draining to that outfall and the sensitivity of the receptor.

3.1.4 As local conditions are not likely to make a significant difference to these risks, these spillage risks will be assessed on a route wide basis.

## 3.2 Roads

3.2.1 The spillage risks for all roads (as per Section 1.1.2), should be assessed using the methodology set out in the Design Manual for Roads and Bridges (DMRB) 11.3.10[1] (HD45) Annex I Method D.

3.2.2 Roads where the annual average daily traffic of Heavy Goods Vehicles is less than 500 are unlikely to pose a significant spillage risk. Assessment of such roads is not required unless there are local conditions that warrant it. Examples of such conditions could include the use of a road to convey highly polluting materials, or the close proximity of a water-sensitive SSSI to the road.

## 3.3 Stations and depots

3.3.1 Roof drainage discharging directly to a drain or water body may be considered not to pose a spillage risk. Areas draining to a foul sewer do not need to be assessed for risk of spillages. Remaining areas, such as those used for the storage of potential contaminants, should be assessed using an appropriate combination of expert judgment and analysis.

# 4 Mitigation measures

4.1.1 Mitigation measures will be identified to avoid, reduce or offset significant spillages risks. These will be described in the Environmental Statement. These may include physical measures, such as spillage basins or control valves, or may include operating procedures, such as spillage kits, contingency plans and drainage layouts showing which section of the project drains to which outfall.

[1] DMRB (2006), Volume 11 Section 3 Part 10: HD45: Road Drainage and the Water Environment. Her Majesty's Stationery Office, London..

4.1.2 For roads, reference should be made to Design Manual for Roads and Bridges (DMRB) 4.2.1[2] (HA 103) and DMRB 4.2.3[3] (HD33). Both documents give examples of suitable measures to reduce spillage risk from roads.

4.1.3 For stations and depots, reference, where necessary, should be made to the Pollution Prevention Guidelines (PPG) published by the Environment Agency:

www.environment-agency.gov.uk/business/topics/pollution/39083.aspx

4.1.4 Of particular relevance are the following PPGs:

- PPG 18: Managing fire water and major spillages;
- PPG 21: Pollution incident response planning; and
- PPG 22: Dealing with spills.

# 5 Reporting residual effects

5.1.1 The Environmental Statement will report the residual effects following the implementation of mitigation measures.

[2] Highways Agency (2009) *DMRB Volume 4, Section 2, Part 1 (HA103), Her Majesty's Stationery Office, London.*
[3] Highways Agency (2009) *DMRB Volume 4, Section 2, Part 3 (HD33), Her Majesty's Stationery Office, London.*