9.3. Study Area

9.3.1. The study area for this assessment considers all locations where physical works and ground disturbance will take place, and in addition extends to 1km beyond this in order to identify any past pollution incidents which may have affected soil within the works area.

9.3.2. DMRB guidance does not provide a set definition of the study area for assessing the effects on agriculture and farm viability. Therefore, the study area has been based on professional judgement and includes all farms, farm access routes, important agricultural infrastructure and agricultural land within the site.

9.4. Assumptions and limitations

9.4.1. With regards to land quality and contaminated land, it should be noted that there are uncertainties and data limitations concerning geochemical makeup, and the characteristics of surface water and groundwater.

9.4.2. There is limited data available concerning the operation of the former Cantley Lane landfill site. No information has been obtained in relation to the extent, depth, distribution and current condition of the deposited waste materials, leachate or ground gas concentrations, or the presence or otherwise of any pollution control measures.

9.5. Baseline

Determining baseline conditions

9.5.1. A desk top review of available geological, soils, historical Ordnance Survey and agricultural maps along with previously published reports and ground investigations were reviewed along with previous site walkover information. This includes evaluation of information from the Highways Agency Geotechnical Data Management System (HAGDMS).

9.5.2. A site walkover survey was undertaken in November 2017 to determine the accuracy of desk study information, and also to identify sites worthy of further investigation.

Designated sites

9.5.3. There are no designated sites, for example Site of Special Scientific Interest (SSSI) or Geological Conservation Review Sites, within the study area that are designated for their geological or geomorphological importance. However, the proposed road works do fall into the wider SSSI Impact Risk Zones designated

around a number of SSSIs mainly relating to chalk pits or ecological systems feeding from the Chalk aquifer.

Artificial ground

9.5.4. Artificial ground is likely to exist in a former gravel pit located within Cantley Wood, west of Cantley Lane. This was subsequently utilised as a landfill site (Landmark Information Group, 2017).

9.5.5. An historical landfill site at Cantley Wood (Cantley Lane Landfill) is recorded on old Ordnance Survey (OS) plans and by the Environment Agency north of Cantley Stream close to where it is culverted below the A11 adjacent to the eastern edge of the A11(618,161.75E; 304,971.25N). Cantley Lane landfill was operated between 1961 and 1969 receiving inert, industrial, commercial and household wastes. There are no records of any monitoring data or any details of environmental / pollution control measures (e.g. landfill liner or peripheral gas vent trench).

Superficial deposits

9.5.6. The anticipated superficial geology underlying the site is comprised of local deposits of alluvium overlying glacial deposits of the Lowestoft Formation - diamicton, and Sheringham Cliffs Formation - sand and gravel, (British Geological Survey (BGS, 2017).

Bedrock geology

9.5.7. The superficial deposits are underlain by chalk of the White Sub-Group, formerly known as the Upper Chalk Formation (BGS, 2017).

Mineral resource

9.5.8. There are no active mines or quarries within the study area. A review of historical maps has shown the presence of disused sand pits and gravel quarries (BGS, 2017).

Agricultural viability

9.5.9. Land use within the study area predominantly comprises agricultural uses (mainly arable production) and hardstanding. Smaller parcels of land are generally perceived to be used as permanent pasture, parkland and woodland and therefore these smaller spaces indicate little agricultural viability.

9.5.10. The quality of the agricultural land is yet to be determined as no detailed Agricultural Land Classification (ALC) surveys have been undertaken to date. There have been four ALC investigations into sites surrounding the Site which

can be used as a proxy to inform the baseline assessment. This proximation can be supported in part by information from Natural England's 1:250,000 ALC map for the eastern region.

9.5.11. The historic ALC surveys indicate that the baseline land classifications within the study area are likely to be Grades 2, 3a and 3b. Natural England's (2010) 1:250,000 ALC map for the eastern region indicates Grade 2 land in the area, supporting the historical investigations.

9.5.12. Grades 2 and 3a agricultural land is classified as 'best and most versatile' land by Defra standards and is considered a national resource.

Farm severance

9.5.13. There are several parcels of agricultural land, of differing size (mostly small fields and parcels of land), within the study area. Access tracks to these fields are also present and are predominately located off side roads. The identification of these features indicates that there is the potential for impacts from the Proposed Scheme where access routes are severed, as this may adversely affect the viability of farm holdings.

Contamination and contaminated land

9.5.14. The assessment of contaminated land takes account of the 'source-pathway receptor' (S-P-R) approach which seeks to establish the potential for a link between a source of contamination and a receptor which may constitute a risk.

Potential contamination sources

9.5.15. The following potential contamination source has been identified from a review of historical maps and other sources of information:

- S1: Cantley Lane landfill site located in a former gravel pit at Cantley Wood. Operational between 1961 and 1969.

Potential contamination transport pathways

9.5.16. The following potential migration pathways have been identified:

- P1: Horizontal and vertical migration of leachate through potentially permeable soils and geological formations
- P2: Migration of contaminants along engineered preferential pathways, e.g. underground services, pipes, tunnels and drainage pathways both surface and culverted
- P3: Surface runoff along roads, pavements, cutting faces etc.
- P4: Root uptake

- P5: Human uptake pathways for a commercial / industrial land use which is considered to be broadly applicable to the proposed development: inhalation, ingestion and dermal contact
- P6: Vertical and lateral migration of volatile vapours and ground gases

Potential receptors

9.5.17. Potential receptors are:

- R1: Groundwater (Principal and Secondary aquifers)
- R2: Surface water bodies
- R3: Subsurface structures
- R4: Flora and fauna
- R5: Construction and Maintenance workers
- R6: Road users

9.5.18. Table 9.1 describes the expected S-P-R linkages which form the initial conceptual site model.

Table **Error! No text of specified style in document.** Summary of the potential S-P-R linkages within the study area.

Source	Receptor	Pathway	Comments
S1 Former landfill site off Cantley Lane	**R1:** Groundwater	**P1:** Horizontal and vertical migration of leachate through potentially permeable soils and geological formations	Principal and Secondary aquifers underlie the route. The risk to groundwater is considered to be moderate.
	R2: Surface water	**P1:** Horizontal and vertical migration of leachate through potentially permeable soils and geological formations	Cantley Brook is in close proximity; the risk to surface water is considered moderate
	R3: Subsurface structures	**P1:** Horizontal and vertical migration of leachate through potentially permeable soils and geological formations **P2:** Migration of contaminants along engineered preferential pathways, e.g. underground services, pipes, tunnels and drainage pathways both surface and culverted **P6:** Vertical and lateral migration of volatile	The risk to in-ground structures is considered to be moderate/low.

Source	Receptor	Pathway	Comments
		vapours and ground gases	
	R4: Flora and fauna	**P1:** Horizontal and vertical migration of leachate through potentially permeable soils and geological formations **P2:** Migration of contaminants along engineered preferential pathways, e.g. Underground services, pipes, tunnels and drainage pathways both surface and culverted **P3:** Surface run-off along roads, pavements, cutting faces etc **P4:** Root uptake **P5:** Human uptake pathways **P6:** Vertical and lateral migration of volatile vapours and ground gases	The risk to flora and fauna is considered to be moderate/ low.
	R5: Construction and maintenance workers	**P5:** Human uptake pathways **P6:** Vertical and lateral migration of volatile vapours and ground gases	The risk is considered to be moderate.
	R6: Road users	**P5:** Human uptake pathways **P6:** Vertical and lateral migration of volatile vapours and ground gases.	The risk is considered to be low.

9.5.19. Soil and groundwater sampling and chemical analysis would be completed as part of the proposed ground investigation (GI). The results would be assessed in line with good practice guidance to produce a revised conceptual site model. The initial S-P-R linkages would be updated based on the data obtained and a remediation options appraisal then completed if appropriate. This identifies the requirement for any remediation works to mitigate any potential risks identified by the process.

9.6. Consultation

9.6.1. The proposed works are not considered to warrant specific consultation in respect of land quality issues i.e. potential sterilisation of mineral reserves and contaminated land risks. The former is unlikely to be a material consideration

owing to the depth of rockhead, and the alignment does not impinge upon significant expanses of surface sand and gravel deposits. The latter will be addressed as part of routine GI and assessment procedures which do not require a specific permit.

9.6.2. Confidential questionnaires are to be issued to landowners and tenant farmers in relation to their agricultural land and farm status. Discussion with the local Planning and Economic Development Officers and key stakeholders (landowners and property agents) will also take place.

9.7. Design interventions

9.7.1. A design intervention is a recommended mitigation from the environment team that has been imbedded into the design.

9.7.2. Restoration of the ground cover affected by road construction at the former Cantley Lane landfill, and provision of road drainage, are anticipated to re-establish baseline environmental conditions.

9.7.3. No additional design interventions are proposed at this stage pending review based on the GI data. The outcomes of the review would be reported in the Environmental Statement (ES), with particular regard to health and safety risks associated with operation and maintenance of assets that may be constructed within Cantley Lane landfill site.

9.7.4. The most applicable mitigation for Agricultural Viability, and Farm Severance is through effective design.

9.7.5. The first principle is to ensure that the footprint of the Proposed Scheme is reduced as much as practicable, without adversely affecting the design. This minimises the total area of agricultural land affected. It also minimises the number of incidents of farm access and irrigation severance.

9.8. Potential mitigation measures

9.8.1. The construction phase would be carried out in accordance with a Construction Environmental Management Plan (CEMP).

9.8.2. The CEMP would contain a Soil Management Plan incorporating guidance provided by the Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra, 2011), to ensure the use of best practice measures for soil handling.

9.8.3. The CEMP would contain a Materials Management Plan / Soil Resource Plan which would outline areas of soil to be protected from earthworks and

construction activities; the areas and types of topsoil and subsoil to be stripped, haul routes, stockpile locations; the methods for stripping, stockpiling, respreading and ameliorating landscape soils, and a cut and fill balance to ensure as much material as possible is re-used in the scheme. An earthworks specification would also be produced, which would provide geotechnical and chemical acceptability criteria to which site-won and imported materials should comply before being used during construction.

9.8.4. The CEMP would set out the procedure for selecting an appropriate landfill site to receive waste materials that may be excavated from Cantley Lane landfill. Waste materials may require excavation and removal from beneath the new road construction on the basis of their geotechnical and chemical properties.

9.8.5. Dust from construction activities would be suppressed using best practice methods such as the use of netting, wheel washing facilities and road sweeping vehicles to prevent the spread of potentially contaminated windblown material. Odour release would be similarly addressed by the CEMP.

9.8.6. Mobilisation of contaminants, either from existing sources or from spillages during works, would be mitigated by the implementation of best practice measures set out in the CEMP. Hazardous substances such as any excavated contaminated land, fuels, chemicals, waste and construction materials would be stored, handled, transported and disposed of in accordance with the CEMP. This should also outline emergency procedures to respond to potential accidental spillages and leaks. To mitigate short-term (acute) risks appropriate construction methods would be adopted to minimise exposure to potentially harmful substances, and suitable Personal Protective Equipment (PPE) employed.

9.8.7. When open excavations are anticipated in any areas of potential contaminated ground, excavations should be lined in order to inhibit water percolation and subsequent leachate generation. Where piling or penetrative ground improvement is required through potentially contaminated ground, the works should be carried out in accordance with published Environment Agency guidance, and a foundation works risk assessment may need to be undertaken.

9.8.8. Clean drilling methods are specified for drilling boreholes which form part of the ground investigation in consideration of the aquifers beneath the site.

9.9. Potential impacts

Construction

9.9.1. The Proposed Scheme would result in impacts on agricultural land and farm businesses during construction, due to potential severance, loss of access and disruption to drainage and irrigation, together with impacts resulting from the

reduction in farm size and / or manageability and / or income because of temporary land-take or severance. These are considered to be negligible/slight adverse impacts.

9.9.2. The location of the new road is potentially within the former Cantley Lane landfill site, the extents of which will be determined via GI and may involve reuse of brownfield (and potentially contaminated) land. This would constitute a permanent negligible/slight beneficial impact due to remediation of the land. However, road construction is likely to involve excavation and off-site disposal to landfill of existing waste materials owing to anticipated poor geotechnical properties. Depending on the amount of waste that may require excavation and disposal, and also in consideration of the corresponding requirement for replacement construction materials, there may be no overall net environmental benefit or negative impact. The volume of waste that may require excavation and disposal is not known at this stage pending the results of the GI.

9.9.3. The CEMP will provide mitigation against any extant soil or groundwater contaminants that may be mobilised by construction activities where pollution of Cantley Stream or groundwater could result. This would constitute a temporary negligible adverse impact associated with road construction potentially within the former Cantley Lane landfill site. Drainage provision and restoration of the ground cover affected by road construction would re-establish baseline conditions in the longer-term.

9.9.4. Construction activities could also create dust which would constitute a temporary negligible adverse impact however the CEMP will mitigate against this.

Operation

9.9.5. In general, geology and soils impacts from road schemes primarily tend to be limited to the construction phase. The newly constructed hardstanding cover may lead to increased surface water run-off during operation however the proposed drainage design will limit the potential for this. Uncontrolled runoff onto adjacent agricultural land may give rise to erosion of soil as a negligible/slight adverse impact.

9.9.6. Potential contamination may arise from fuel spills associated with use of the new road where built on existing agricultural land. This is considered to be a negligible/slight adverse impact.

9.9.7. Maintenance and operation of new assets that may be constructed within Cantley Lane landfill will require task-specific risk assessments to safeguard workforce and asset functionality. This needs to be based on the results of the GI planned for the Proposed Scheme.

9.9.8. The Proposed Scheme would result in permanent impacts on agricultural land including soils as a national resource as well as farming businesses because of land-take and the severance and loss of access, disruption to drainage, irrigation and impacts resulting from reductions in farm size and / or manageability and / or income because of land-take, severance or loss of buildings.

9.10. Chapter summary

9.10.1. This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon Geology & Soils.

9.10.2. Without appropriate design interventions and mitigations measures, impacts are likely during the construction and operational phases due to the nature of the works from the Proposed Scheme. Soil compaction adjacent to new road corridor, contamination of site soils and creation of contamination transport pathways to controlled waters from extant landfill wastes have been identified as potential impacts.

9.10.3. Further work will be undertaken to develop design interventions to limit or reduce impacts and promote opportunities for the environment within the study area wherever possible.

9.10.4. Design development and potential mitigation will be reported in the ES as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

10. Materials

10.1. Introduction

10.1.1. This chapter presents the preliminary findings of the materials impact assessment. This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme upon Materials. Consultation is identified where relevant to the content and focus of the chapter. The chapter also outlines proposed design measures to help mitigate potential material impacts.

10.2. Guidance and best practice

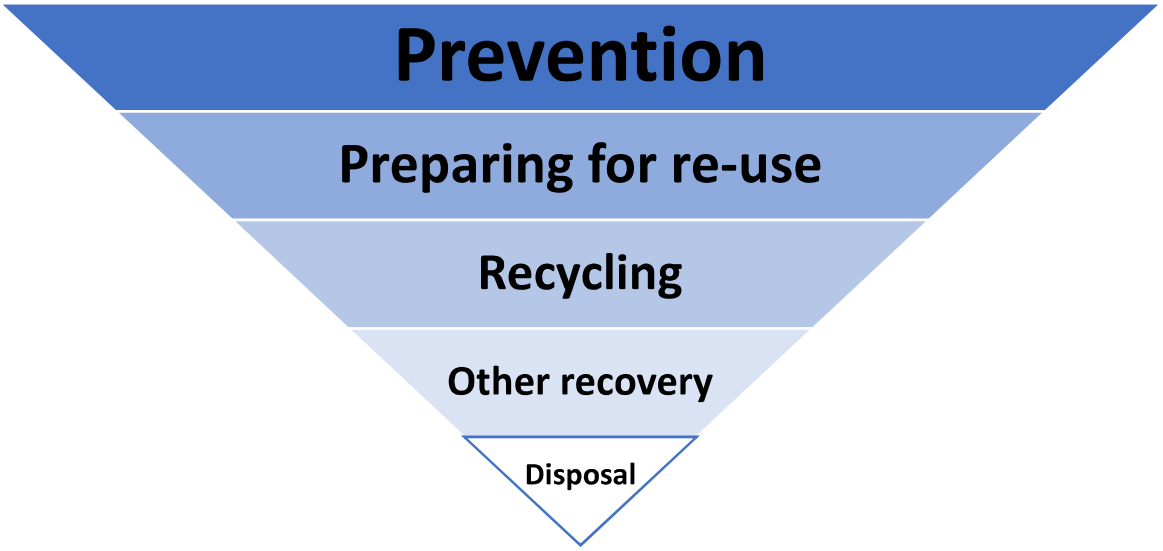
10.2.1. The following legislation, standards and best practice guidelines are considered relevant to the Proposed Scheme which regulate the management of materials and waste:

- EU Waste Framework Directive 2008/98/EC
- Waste (England and Wales) Regulations 2011 (as amended 2012)
- Environmental Protection Act 1990, Part II, Section 34
- Hazardous Waste (England and Wales) Regulations 2005 (as amended, 2016)
- Environment Permitting (England and Wales) Regulations 2010 (as amended 2011 and 2012)
- Environment Agency (Standard Rules SR2015 No39: use of waste in a deposit for recovery operation
- CL:AIRE Definition of Waste: Development Industry Code of Practice Version 2, 2011
- Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites, 2009
- Interim Advice Note 153/11 Guidance on the Environmental Assessment of Material Resources (Highways Agency, 2011)
- Major Projects' Instructions, Environmental Impact Assessment: Implementing the Requirements of 2011/92/EU as amended by 2014/52/EU (EIA Directive) (Highways England, 2018)

10.2.2. Legislation setting out the requirement for Site Waste management plans (SWMP) was released in December 2013, however the use of a SWMP is regarded as best practice and adopted by Highways England. The SWMP aims to determine the waste types and amounts to be produced during design and construction and to identify appropriate waste management controls.

10.2.3. The Waste Framework Directive (2008/98/EC) sets the basic concepts and definitions in relation to waste management, providing an overarching framework for waste management and requirement to prioritise waste prevention. This waste hierarchy (see figure 10.1) is a fundamental principal to reduce waste generation at source and minimise the volume of waste sent to landfill.

Table 5.1 Air Quality Objectives **Error! No text of specified style in document.**2 Waste hierarchy



10.3. Study area

10.3.1. The assessment establishes two geographically different study areas, which are used to examine the use of primary/secondary /recycled/ manufactured materials; and the generation and management of waste.

10.3.2. The first study area includes land within the Proposed Scheme boundary (referred to hereafter at the Site') where the proposed design footprint, site clearance, drainage, earthworks and construction are proposed.

10.3.3. The second study area considers the location of appropriate waste management facilities which could accept arisings or waste generated by the Proposed Scheme, as well as the location of feasible sources of construction materials.

10.4. Assumptions and limitations

10.4.1. At the time of writing detailed information or estimates on the quantity of materials and generation of waste arisings from the Proposed Scheme are not available. Therefore, this section will be applicable to the Environmental Statement (ES) and are noted here as an indication of the anticipated assumptions and limitations.

10.4.2. The potential impacts associated with material use and the production, movement, transport, processing and disposal of waste is assessed based on estimates of the type and quantity of materials at the preliminary design stage. Estimates of material volumes are not yet available. These volumes may also change at the detailed design stage.

10.4.3. Estimates on the volumes of inert, non-hazardous and hazardous waste from earthwork activities are to be based on ground investigation results and the anticipated ratio of made ground and natural soils to be excavated. For this report, this data is not yet available and is to be reported in the ES.

10.4.4. A net import of earthwork material is expected, however, the re-use of any site-won material would be undertaken, where appropriate. Site-won material which is geotechnically or chemically (due to the presence of soil contaminants at unacceptable concentrations) unsuitable for re-use would require disposal or treatment prior to any re-use off-site.

10.4.5. For materials and removal of waste, these are classed according to whether they are likely to be sourced, re-used / recycled or disposed of on a regional (for example within 120km), national or international level. These assumptions depend on the type of material / waste, availability of regional facilities, suppliers and manufacturers. Specific suppliers are not selected at this preliminary design stage and assumptions are based on typical procurement options used for similar highway schemes.

10.5. Baseline

Material resources

10.5.1. There are no current estimates on material resource use and waste generation during the site remediation / preparation, demolition and construction phases. These shall be developed as the design is progressed.

10.5.2. The former Cantley Lane landfill has been identified as a potential source of contamination which may give rise to the need to manage, treat and dispose of contaminated materials during construction where removal from beneath or adjacent to the Proposed Scheme is required on the basis of their geotechnical and chemical properties.

10.5.3. Information on the geology (including the potential for peat resources) is addressed in Chapter 9 Geology & soils. The potential impact on peat resources due to the Proposed Scheme will be assessed in the ES.

10.5.4. Where construction waste associated with the Proposed Scheme cannot be re-used either on or off-site, direct impacts may result from the demands on the

capacity of waste management facilities and landfills and impacts associated with transport. Therefore, capacity of waste management facilities in the region are considered to assess the impact of the Proposed Scheme. Identified licenced waste management facilities in the study area are listed in Table 10.1.

10.5.5. Commercial construction and demolition waste is identified as by far the most significant source of inert waste in Norfolk and there is the need for additional inert waste recycling infrastructure within the region.

10.5.6. There are a number of regional sand and gravel quarries, including secondary and recycled aggregate resources within Norfolk. The regional, national or international sourcing of other construction materials would be represented in the ES.

Table **Error! No text of specified style in document.**1: Licenced waste management facilities

Site Name	Site Address	Type of Waste Accepted	Approximate distance from the Proposed Scheme
Easton Inert Landfill	Dereham Road, Costessey, NR9 5EQ	A05: Landfill taking non-biodegradable (inert) wastes	6.3km
Postwick Waste Site	Griffin Lane, Saint Andrew, Norwich, NR7 0SL	A06: Landfill taking wastes other than hazardous, non-hazardous and inert wastes	10km
Attlebridge Landfill	Reepham Road, Attlebridge, NR9 5TD	A06: Landfill taking wastes other than hazardous, non-hazardous and inert wastes	10.7km
Spixworth Quarry	Buxton Road, Spixworth, NR10 3PR	Inert waste	11.7km
Lyng Sand & Gravel Pit	Easthaugh Road, Lyng, NR9 5LN	A05: Landfill taking Non-Biodegradable Wastes (Non-hazardous)	15.4km

10.6. Consultation

10.6.1. No specific consultation has been undertaken to date regarding materials and waste.

10.7. Design interventions

10.7.1. The principles of value engineering have been adopted by the Design Team to optimise the alignment and reduce costs, where appropriate. This would directly decrease the impacts from the use of materials. Further opportunities to reduce

may also be achieved at the detailed design stage and will be reported in the environmental statement (ES).

10.8. Potential mitigation measures

10.8.1. For this report, specific quantities of materials and waste are not available and would be reported in the ES. Potential opportunities to re-use surplus material within sections of the A47 where improvements are planned (or any other local projects concurrent to the construction phase) would mitigate the impacts from the use of material and generation of waste arisings.

10.8.2. Employing the waste hierarchy during the construction phase has the potential to mitigate impacts of material use; the principals promote prevention and re-use over disposal, therefore reducing overall material use.

10.8.3. A combination of the SWMP (including a Materials Management Plan, MMP) and the appointed contractor's Construction Environmental Management Plan (CEMP) would ensure that adverse impacts associated with materials use, waste generation and required transport are managed.

10.8.4. Mitigation measures in the SWMP and CEMP would potentially include (but not be limited to):

- implementation of the waste hierarchy and avoiding generation of waste through design
- use of site-won or recycled materials as opposed to sourcing new materials
- where surplus materials cannot be re-used on-site, seek opportunities for re-use off-site, including other A47 schemes or other projects off-site (for example quarry restoration scheme)
- use of material logistics planning to manage procurement, storage and use of materials and minimise damage, over ordering and wastage
- encourage local and responsible resourcing of materials (e.g. through adoption of BES 6001) and efficiencies by minimal ordering of materials
- waste to be appropriately segregated and stored/stockpiled on-site by waste type, to ensure waste remains in a suitable condition to be re-used
- where waste must be taken to a recycling / disposal site, ensure these sites hold the appropriate permits

10.9. Potential impacts

Construction

10.9.1. There is the potential for adverse impacts during construction due to the anticipated use of materials and generation of waste typical for a road infrastructure scheme of this size. The Proposed Scheme includes earthworks, construction of the mainline road alignment, side roads, associated structures, embankment ramps, reinforced concrete foundations, abutments and use of precast deck beams. These are summarised in Table 10.2.

Table **Error! No text of specified style in document.**2: Summary of materials and waste that have the potential to generate environmental impacts

	Material use and potential to generate impacts	Potential waste arisings and potential to generate impacts
Activity:	Potential direct impacts associated with the import and use of materials, including: depletion of natural resources; noise and air emissions associated with their transportation; energy / fuel consumption through plant use and transportation; energy / fuel consumption through manufacture.	Potential direct impacts associated with the generation of waste arisings (inert, non-hazardous, green and hazardous) including: demand on handling / disposal capacity of regional waste management facilities; release of contaminants to air, land or water; noise and air emissions associated with their transportation / handling; energy / fuel consumption through plant use and transportation.
Site remediation / preparatory / earthworks	Materials include: • Bulk materials for earthwork • Timber (e.g. for temporary use for shuttering)	Waste arisings include: • Surplus / unsuitable topsoil or subsoil arising from earthworks • Invasive plant species (e.g. Japanese knotweed) and injurious weeds • Hazardous or contaminated soils encountered on-site (including potential for landfill wastes and asbestos containing materials) • Vegetation and other above ground materials produced by site clearance (e.g. litter, fly tipped waste)
Demolition	Materials include: • n/a	Waste arisings include: • Demolition waste from removal of structures, footways and culvert modifications
Construction	Materials include: • Road sub-base and surface materials • Concrete, steel and other structural materials • Pre-cast and prefabricated products (e.g. kerbs, gullies, barriers, manholes, drainage) • Signage, lighting columns and markings • Timber (e.g. for temporary use for shuttering) • Topsoil	Waste arisings include: • Surplus, damaged and 'cut-off' construction materials

Operation

10.9.2. Environmental impacts from the use of materials and generation of waste are unlikely during the operation of the Proposed Scheme since there would be minimal requirements for materials, besides infrequent maintenance activities.

10.10. Chapter summary

10.10.1. The chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon material use and waste.

10.10.2. There is the potential for adverse impacts during construction due to the anticipated use of materials and generation of waste typical for a road infrastructure scheme of this size. Operational impacts from the use of are considered to be unlikely.

10.10.3. Further work would be undertaken to develop design interventions to limit or reduce adverse impacts and promote opportunities for the environment in the study area wherever possible.

10.10.4. Any design development and potential mitigation would be reported in the ES as well as further detailing of baseline conditions and material volumes.

11. Noise and vibration

11.1. Introduction

11.1.1. This chapter presents the preliminary findings of the noise and vibration assessment. This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme in the context of noise and vibration. Consultation is identified where relevant to the content and focus of the chapter. The chapter also outlines proposed design measures to help mitigate potential noise and vibration impacts.

11.2. Guidance and best practice

11.2.1. The following legislation, standards and best practice guidelines are considered to be relevant to the Proposed Scheme:

- The National Planning Policy Framework 2019
- The Noise Policy Statement for England 2010
- Planning Practice Guidance (noise) 2014
- The National Policy Statement for National Networks 2014
- The Land Compensation Act 1973 Part 1
- The Noise Insulation Regulations 1975 (amended 1988)
- Sections 60 and 61 of The Control of Pollution Act 1974
- British Standard (BS) 5228-1:2009+A1:2014, Code of practice for noise and vibration control on construction and open sites – Part 1: Noise
- BS5228-2:2009+A1:2014, Code of construction practice for noise and vibration control on construction and open sites - Part 2: Vibration
- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 7, Noise and Vibration, (HD213/11 – Revision 1) (Highways Agency, 2011)
- Calculation of Road Traffic Noise (CRTN) 1988
- Guidelines for Noise Impact Assessment, Institute of Environmental Management & Assessment, 2014

11.3. Study area

11.3.1. The study area for operational nose is defined in accordance with Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 7 and predominantly involves calculation of the noise levels at up to 600m from the new carriageway edge as well as consideration of any other affected routes (where there is a change of 1 dB in the short-term or 3 dB in the long-term).

11.3.2. Typically for construction activity, noise will be calculated at distances up to 300m and vibration at distances up to 100m depending on the noise and vibration characteristics of the plant that are used.

11.3.3. The impact of construction traffic on the local network would also be considered.

11.4. Assumptions and limitations

11.4.1. This chapter is based on a desk-top study and is qualitative but is informed by historical noise measurements and the Defra Noise map which is a product of the strategic noise mapping exercise undertaken by Defra in 2012 to meet the requirements of the Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2006 (as amended).

11.5. Baseline

11.5.1. There is a hotel, petrol station and two fast food restaurants in the immediate vicinity of the Thickthorn Junction. Small groups of residential properties are located at East Lodge/Thickthorn Cottages on the B1172 (six properties approximately 140m to 260m from the A47) and Cantley Lane South (group of 12 properties approximately 55m to 160m from the A47), both situated to the west of Thickthorn Junction.

11.5.2. A number of individual properties are also located further south on Cantley Lane South. The individual residential property the Round House is located to the east of Thickthorn Junction approximately 50m north of the A11. A large number of residential properties are concentrated in Cringleford to the east of the A47, both to the north and south of the A11. The western edge of Cringleford is a minimum of approximately 170m from the A47. Residential properties in Cringleford extend to within approximately 15m of the A11.

11.5.3. No designated ecological sites (Sites of Special Scientific Interest (SSSI), Special Protection Areas (SPA) Special Area of Conservation (SAC), Area of Outstanding Natural Beauty (AONB) or National Parks are located in the operational noise study area. The Scheduled Monument ‘Two Bronze Age round barrows’ are located approximately 40m and 230m respectively south-east of the A11, between Cantley Lane South and the A11. An additional Scheduled Monument is located towards the eastern edge of the study area at Cringleford Bridge. Several public rights of way are located in the study area: the closest to Thickthorn junction are the footpath crossing the A47 between Cantley Lane and Cantley Lane South, and the footpath connecting Cantley Lane to the Round House roundabout. A primary school, church, doctors' surgery and various community buildings, including the Willow Centre and St Peters Church Hall, are located in Cringleford. None are in the immediate vicinity of the junction.

11.5.4. The predominant noise sources in the area are the A11 and A47 and this would continue to be the case with the Proposed Scheme. Modelled noise data (Defra, 2012) shows that receptors at the eastern end of Cantley Lane South, at the Round House, and on Newmarket Road, Cringleford are close to the 55dB L_{night}, contour: an L_{night} of 55dB is the World Health Organisation (WHO) recommended (WHO, 2009) Interim Target (IT) Level for night-time noise where the Night Noise Guideline value of 40 dB cannot be achieved in the short-term and where policy makers choose to adopt a step-wise approach to reduce night-time noise. All other receptors are likely be exposed to noise levels below the IT level.

11.5.5. A noise survey was carried out at three locations close to residential receptors in June 2016. The survey followed the CRTN shortened measurement procedure to estimate the $LA_{10,18h}$ index that is used in the UK to characterise day-time road traffic noise. The three locations were on Cantley Lane South to the south west of the, A47, Cantley Lane to the east of the A47 and on Newmarket Road, east of the Round House roundabout and approximately 15m from the kerb of the A11.

11.5.6. It was noted that road traffic noise was the dominant noise source at all three monitoring locations. At Cantley Lane South, local road traffic movements arose in addition to distant and more constant traffic on the A47 and A11. At Cantley Lane, no local road traffic was observed in the vicinity of the meter at the time of the survey, only more distant traffic on the A47 and A11. On Newmarket Road, local traffic passed the monitoring location, but the volume of traffic on the A11 and its close proximity meant that the A11 was the dominant noise source although noise from occasional pedestrians, dogs and sirens was also noted.

11.5.7. The estimated noise levels derived from these measurements are shown in Table 11.1. To set these numbers into context, the 'specified level' in the Noise Insulation Regulations, 1975 (amended 1988) is a $LA_{10,18h}$ of 68dB façade level corresponding approximately to a free-field level (as reported for the noise survey) of approximately 65dB and is the level, subject to additional criteria, associated with grants in respect of the carrying out insulation work. In all three cases the estimated $L_{10,18h}$ falls below this level.

Table **Error! No text of specified style in document.**1: June 2016 survey results

Location	Estimated $L_{10,18h}$ [dB(A)]
Cantley Lane South, south-west of the A47	57
Cantley Lane, east of the A47	58
Newmarket Road, east of the Round House roundabout	66

11.5.8. There are two such NIAs within the study area and it is particularly important to avoid increasing noise in these areas.

Table **Error! No text of specified style in document.**2: Noise important areas

Location	Estimated $L_{10,18h}$ [dB(A)]
4965	On the A11 east of the Round House roundabout, Cringleford but west of Keswick Road
4966	On the A11 east of Keswick Road, Cringleford but west of the River Yare

11.6. Consultation

11.6.1. There has been no consultation with statutory consultees on noise and vibration aspects to date. Consultation will be undertaken in response to comments received in the scoping opinion from the Planning Inspectorate (PINS).

11.6.2. The scope and methodology would be discussed with the local authority as the Proposed Scheme progresses and specifically the need to produce a Construction Environmental Management Plan (CEMP) and Section 61 Certificate (Control of Pollution Act, 1974) will be discussed.

11.7. Design interventions

11.7.1. A low noise running surface would be used within the design; this is estimated to reduce noise by ~3dB at typical highway speeds in comparison with conventional hot rolled asphalt.

11.8. Potential mitigation measures

11.8.1. Potential adverse noise impacts during construction would be mitigated through measures included within the CEMP, which would be prepared alongside the Environmental Statement (ES).

11.8.2. Acoustic barriers can be effective at reducing noise for receptors close to the source, during both construction and operation, and would be considered in the ES for sensitive receptors that may be affected by the Proposed Scheme.

11.9. Potential impacts

Construction

11.9.1. The main activities during the construction phase which would generate noise and vibration are:

- demolition of existing structures and carriageway
- excavation, compaction and foundations works

- construction of bridges, retaining structures, services, drainage and the new carriageway
- surfacing
- installation of noise barriers, signage, gantries and road markings

11.9.2. Vehicles accessing the site and compounds for the delivery of materials and equipment, carrying muck away, attendance of site personnel and more would also generate noise.

11.9.3. Noise impacts due to the construction of the Proposed Scheme are expected to be perceptible at nearby sensitive receptors particularly in Cantley Lane South and in Cringleford.

11.9.4. The variable nature of construction noise is such that it is difficult to accurately predict the noise impacts at given receptors over the period of the construction phase. However, given the proximity of some residential receptors to the existing A11 and A47 routes and of Cantley Lane South to the proposed slip road from the A47 to the A11, potential impacts have been identified and careful management – particularly for any construction activity at night – would be required. Vibration impacts may also arise during demolition of existing structures, piling and surfacing if vibratory rollers are used.

Operation

11.9.5. Operational impacts from noise and vibration could arise from changes in traffic composition and flow (volume and speed), new carriageways and re-alignment of existing carriageways. Road traffic may generate ground-borne or air borne impacts associated with vibration.

11.9.6. All newly-constructed carriageways would comply with current specifications, therefore ground-borne vibration from the Proposed Scheme are unlikely to generate of perceptible levels of vibration. Relatively high levels of noise are required to cause perceptible levels of airborne vibration and therefore noise-induced vibration is only likely to occur at properties close to heavily-trafficked road links.

11.9.7. While increases in traffic volume and speed tend to increase noise, in the absence of traffic data it is not possible to state if there would be any net beneficial or adverse impacts due to the Proposed Scheme. The alignment changes may also have a positive impact (when traffic is moved further from receptors) and when any potentially negative impacts may be mitigated by the introduction of bunds or barriers.

11.9.8. The predominant potential operational adverse noise impact will be for the 12 properties on Cantley Lane South where the new exit slip from the A47 (from Great Yarmouth) to the A11 (towards Newmarket) will introduce a noise source. It may be possible to partially mitigate this with a combination of noise barriers and vertical alignment. Changes in traffic flow may also result in noise increases for properties that are east of the A11/A47 Thickthorn Junction (including those within the noise important area to the east of the Round House roundabout) and noise barriers or bunds along the A11 and A47 may be able to offset these.

11.10. Chapter summary

11.10.1. This chapter has identified potential noise and vibration impacts of the Proposed Scheme, both short-term temporary impacts associated with construction activities and long-term permanent impacts due to road traffic noise. Sensitive receptors in proximity to the Proposed Scheme have been identified.

11.10.2. Receptors that are close to the A11 and A47 are already exposed to relatively high noise due to road traffic.

11.10.3. Noise impacts due to the construction of the Proposed Scheme are likely at nearby sensitive receptors; particularly in Cantley Lane South and for receptors in Cringleford and would be controlled by a CEMP.

11.10.4. Any change in road traffic noise due to the introduction of the new slip roads, changes in alignment, changes in traffic mix and speed, road surface and any barriers or bunds would be calculated and assessed in detail for the ES and design interventions would be incorporated to avoid or reduce impacts where possible.

12. People & communities – travellers

12.1. Introduction

12.1.1. This chapter presents the preliminary findings of assessment relevant to travellers, walkers, cyclists and horse riders (WCH), motorised travellers (MT) and including public transport. This chapter comprises a review of the existing environment and identification of potential impacts of the Proposed Scheme. Potential impacts are discussed, considering relevant policy and legislation and in the context of walkers, cyclists and horse riders and vehicle travellers.

12.2. Guidance and best practice

12.2.1. People and Communities is identified as a Design Manual for Roads and Bridges (DMRB) topic within Interim Advice Note (IAN) 125/15 (Highways England, 2015). People and communities is a broad topic and therefore, for ease of assessment and review, the assessment of people and communities for this report has been split into two chapters. Chapter 13, people and communities - social presents the assessment of the social elements of people, communities, local economy and agriculture and this chapter presents the assessment for the 'travellers' elements of people and communities.

12.3. Study area

12.3.1. No study areas for the assessment of WCH, amenity, MT driver stress and MT views from the road are specified in the DMRB Volume 11 Section 2 Part 4 and the DMRB Volume 11 Section 3 Parts 8 and 9. Therefore, the study areas used in the assessment have been defined through professional judgement, based on the type and scale of the Proposed Scheme and the context of the surrounding area. These study areas are considered more than sufficient in terms of identifying the impacts in full.

12.3.2. The study areas used for this assessment are as follows:

- **WCH:** all WCH facilities including public rights of way (PRoW), permissive WCH routes, footways, long distance walks and cycle routes identified within 250m from the land within the Development Consent Order (DCO) site boundary (referred to hereafter as 'the Site').
- **Amenity**: all WCH facilities including PRoWs, permissive WCH routes, footways, long distance walks and cycle routes identified within 250m of the Site.
- **MT driver stress**: comprises all roads and connecting roads within 250m of the Site.

- **MT view from the road**: considers views from the proposed route alignment in operation only.

12.4. Assumptions and limitations

12.4.1. This assessment relies on desk-based studies, using publicly available information where available. This information includes strategic documents, Geographical Information Science (GIS) software and previous assessments undertaken.

12.4.2. Traffic data has not been used to support the assessments for amenity and driver stress. Therefore, the assessments are qualitative in nature and will be considered in further detail in the Environmental Statement (ES).

12.5. Baseline

12.5.1. The A47/A11 Thickthorn Junction is located on the south-western edge of Norwich and provides access to the A47 via the A11 for Eaton, Cringleford and Wymondham. Connected to the west of the Junction is Thickthorn park & ride and highway service facilities area.

Motorised travellers: driver stress

12.5.2. Previous studies have identified the unsuitability of the current junction layout to accommodate the dominant movements through the junction on the A11 and between A11 northbound to A47 eastbound and the A47 westbound and A11 southbound carriageways, in addition to the strong tidal movement through the junction on the A11 during both peak hours. This leads to congestion during the peak periods resulting in driver stress.

Views from the road

12.5.3. Existing views from the A47, A11 and B1172 are intermittent; partially screened by highway boundary vegetation and by tree cover within the wider surrounding landscape. The surrounding landscape typically comprises gently undulating arable land interspersed by small woodland blocks. To the east of the A47 the residential edge of Cringleford is visible on the Norwich suburbs. Thickthorn park & ride and highway service facilities are visible to the west of Thickthorn Junction whilst a line of high voltage powerlines are notable skyline features along the A47 highway corridor. Cantley Lane and Cantley Lane South have restricted views enclosed by hedgerows.

Walking, cycling and horse riders

12.5.4. A number of PRoW and other key routes have been identified within the study area. These routes provide an important means of access for local people to community facilities and the wider study area and are described below:

- Cringleford footpath FP4a runs from Cantley Lane to a footbridge over the A47, providing a link to Cantley Lane South
- Cringleford bridleway BR5 which runs from Cantley Lane to Norwich Southern Bypass
- Cringleford footpath FP1 runs from Cantley Lane to Newmarket Road
- Cringleford footpath FP2 runs south from Cantley Lane to Langley Close
- Cringleford footpath FP3 runs south west from Brettingham Avenue to Kedleston Drive
- Keswick bridleway BR5 runs to the east of the A47 at Intwood
- Hethersett footpath FP6 which runs along Cantley Lane South parallel to Hethersett Bypass
- Norwich Circular via Saxlingham local cycle route
- Cringleford Cycle Route
- Cringleford to Sprowston Pedalway
- the Outer Circuit Pedalway
- Kett's Country Local walking route from Cringleford to Wymondham and from Cringleford to Attleborough, which follows Intwood Road
- a shared-use footway on the northern side of the junction passing under the A47 alongside the junction

12.5.5. The local cycle route at Cantley Lane and one pedalway, namely Cringleford to Sprowston, are impacted by the Proposed Scheme but are of low sensitivity. The footbridge over the A47 connecting Cantley Lane to Cantley Lane South is impacted by the Proposed Scheme but is of low to medium sensitivity. Cringleford footpath FP4a and Cringleford bridleway BR5 are impacted by the Proposed Scheme but are of low sensitivity.

12.5.6. WCH surveys were undertaken in the area of Thickthorn Junction, the A11/Round House Way roundabout and Cantley Lane/Cantley Lane South, in both the school term time and school summer holidays in 2017, to provide information on current usage. The surveys confirmed the most common routes for cyclists using the network and pedestrian demands at key crossing points in the area. They indicated that both pedestrians and cyclists make use of the Cantley Lane footbridge and they also observed that the equestrian route and

associated Pegasus crossing facilities located on the A47 northbound off-slip were not used by equestrians during either of the surveys.

Amenity

12.5.7. There is one crossing facility over the A47 for WCH within the study area in addition to the facilities provided at Thickthorn Junction. This comprises the footbridge connecting Cantley Lane to Cantley Lane South. Amenity varies per WCH facility depending on the barriers between people and traffic and at points where WCH cross existing roads.

12.6. Consultation

12.6.1. A meeting was held on Thursday 23 November 2017 with Norfolk County Council's cycling & active travel officer and the highway manager south to discuss Thickthorn Junction and its impacts on walkers, cyclists and horse riders. A summary of the key points raised is provided in Table 12.1.

Table **Error! No text of specified style in document.**1: Summary of Consultation Responses

Consultee	Comment	Date	Response
Norfolk County Council active travel officer and highway manager south	Replacing the footbridge connecting Cantley Lane to Cantley Lane South on a like for like basis would not provide access for the full range of non-motorised users which may wish to make east to west journeys. Similarly, the existing design does not cater for wheelchair users or others with impaired mobility.	23 November 2017	The Proposed Scheme includes a grade-separated walking, cycling and horse-riding link to connect Cantley Lane to Cantley Lane South. The replacement bridge would allow unrestricted use by people in wheelchairs and those with pushchairs.
Norfolk County Council active travel officer and highway manager south	The northern east to west WCH route through the junction is on a popular commuting route. Crossing the north-facing slip roads is via Toucan crossings which appear to be set to favour motor vehicles on the roundabout.	23 November 2017	A bid has been submitted to the Department of Transport (DfT) Cycling, Safety & Integration fund for the provision of a grade-separated pedestrian and cyclist link over the A47 and the north-facing slip roads.
Norfolk County Council active travel officer and highway manager south	The southern east to west WCH route through the junction was introduced to enable equestrians to travel between Cantley Lane and Cantley Lane South. However, there is no evidence of the Pegasus crossing facilities on the slip roads, nor the bridleways adjacent to the slip roads ever being used.	23 November 2017	The Pegasus crossing facilities would be removed as equestrians would be able to use the proposed link connecting Cantley Lane to Cantley Lane South.

12.7. Design interventions

12.7.1. The Proposed Scheme includes a grade-separated walking, cycling and horse-riding link to connect Cantley Lane to Cantley Lane South. The replacement bridge will allow unrestricted use by people in wheelchairs and those with pushchairs. The Proposed Scheme would remove the existing Pegasus crossing facilities at the junction as equestrians would be able to use the proposed link connecting Cantley Lane to Cantley Lane South.

12.8. Potential mitigation measures

Construction

12.8.1. At this stage, the following best practice measures are anticipated to be of relevance for the scheme during construction:

- A Construction Environmental Management Plan (CEMP) would be prepared by the appointed Contractor and implemented during the construction period. The CEMP would ensure that the construction of the scheme is undertaken in as sensitive a manner as possible, with regards to people within the local community.
- A Traffic Management Plan (TMP) would be implemented during the construction phase of the scheme. The TMP would ensure that access is maintained and disruption is minimised as far as possible wherever practicable and would include measures to minimise severance by ensuring diversions for pedestrians are well signed, alternative access arrangements are made, and access to properties are retained.
- Impacts upon WCHs would be minimised through ensuring that all temporary diversions for users of WCH amenities around the work site are clearly signed, with alternative access arrangements maintained through the full construction period, as required.

Operation

12.8.2. A number of the proposed mitigation measures considered in this Preliminary Environmental Information Report (PEIR) have an influence on the nature and extent of views from the road. These include environmental barriers, the planting of trees and other vegetation to screen views of the road and associated traffic from visually sensitive receptors such as nearby residents or to provide landscape or ecological mitigation. These measures are to be assessed in the ES.

12.9. Potential impacts

Construction

MT: Driver Stress

12.9.1. Construction works could cause temporary disruption for MT along the A47, A11 and adjoining side roads. Traffic management would be likely to result in temporary reduced speeds and potentially narrow lanes, which would increase journey times. This could temporarily increase stress for MT and cause disruption for local communities. However, this would be managed through the implementation of a traffic management plan (TMP) to mitigate temporary impacts.

Views from the road

12.9.2. Construction would result in the loss of existing highway boundary vegetation from both sides of the A47 between the Cantley Lane (Cringleford footpath FP4) pedestrian overbridge and the Norwich to Ely railway line. Views from the road would locally open out from the highway corridor, extending across fields towards the residential edge of Cringleford in the north and across fields to residential properties along Cantley Lane South and a wooded backdrop to the south.

12.9.3. The A11 would experience a localised loss of existing highway boundary vegetation at the points of merge and diverge of the A47 link roads and within the footprint of the Cantley Lane South overbridges. Whilst the vegetation loss would locally increase the extent of views within the immediate highway corridor the relative nature of views out from the highway would remain comparable to those of the baseline.

12.9.4. Views from both the A47 and A11 would be subject to the apparent influence of construction works associated directly with the highway corridor rather than resulting in a change to the view out from the road. Construction works associated with the Cantley Lane South overbridges and excavation of cuttings associated with the A11 to A47 link road would be notable features of the view. The nature of outlook during construction would overall remain one characterised by ‘intermittent’ views.

WCH

12.9.5. The existing footbridge over the A47 connecting Cantley Lane and Cantley Lane South, which carries Cringleford footpath FP4a, would be retained during the construction period until such time as the proposed WCH bridge has been constructed and is open for use. As such, there would be no impact on users of

Cringleford footpath FP4a. The Proposed Scheme would see the removal of Cringleford bridleway BR5, resulting in a potential adverse impact, however there is no evidence to date of usage of this WCH route.

Amenity

12.9.6. Amenity is likely to be temporarily impacted for users of Cringleford footpath FP4a and the existing facilities provided by the junction during construction through the presence of construction plant, machinery, materials, construction compounds and construction lighting, whilst there is also potential for barriers and traffic flows to change. Amenity for users of Cringleford bridleway BR5 would be permanently impacted since the Proposed Scheme would see the removal of this WCH route.

12.9.7. In addition, construction activities may cause indirect impacts for WCHs, due to noise, dust and the presence of construction plant, materials, compounds sites and machinery for a temporary period.

Operation

MT: Driver Stress

12.9.8. Driver stress would be reduced as a result of the Proposed Scheme removing the dominant traffic movements from the junction leading to a reduction in peak hour congestion.

Views from the road

12.9.9. At year one of operation, prior to the establishment of Proposed Scheme mitigation planting, there would be localised ‘open’ views from sections of the A11 and A47, but overall resulting in an ‘intermittent’ highway viewing experience. The bridge structure associated with the highway link between Cantley Lane South and Norwich Road would locally accentuate the influence of highway infrastructure in views from the A11, whilst the link road itself would afford new, ‘open’ views across the surrounding area.

12.9.10. By year 15 of operation views would become more enclosed with establishment of highway boundary mitigation vegetation, but again balanced by potential for views through gaps in planting to maintain the baseline ‘intermittent’ nature of views. Views from the Proposed Scheme Cantley Lane South to Norwich Road link road would become partially enclosed by mitigation planting resulting in a change from year one ’open’ to year 15 ‘intermittent’ views from the road.

12.9.11. The nature of view from the road at year one of operation prior to the establishment of mitigation planting would include the apparent influence of Proposed Scheme highway infrastructure including highway surfacing, cutting

and embankment landform and bridge structures. By year 15 of operation Proposed Scheme mitigation planting would have integrated the Proposed Scheme to a point whereby the appearance of highway components would be comparable to those experienced in the baseline.

WCH

12.9.12. The Proposed Scheme would have a direct impact on WCH since it would provide a new overbridge spanning the A47 and connecting Cantley Lane to Cantley Lane South which would be suitable for pedestrians, cyclists and equestrians. The new overbridge, which would carry Cringleford footpath FP4A, would maintain crossing movements. Although it will result in a minor increase in journey times and lengths, the new overbridge will have a potential beneficial impact on WCH.

12.9.13. The Proposed Scheme would see the removal of Cringleford bridleway BR5 and the Pegasus crossing facilities.

Amenity

12.9.14. The Proposed Scheme will result in a potential adverse impact for users of Cringleford footpath FP4a.

12.10. Chapter summary

12.10.1. This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon travellers.

12.10.2. Construction works could temporarily increase stress for motorised travellers and cause disruption for local communities. This would be managed through the implementation of a TMP. During operation, driver stress would likely be reduced as a result of the Proposed Scheme removing the dominant traffic movements from the junction leading to a reduction in peak hour congestion.

12.10.3. During construction, views from the road would be subject to the detracting influence of construction operations including earthworks and construction vehicles but would otherwise retain intermittent views of the wider area. During operation, views from the road would initially include localised sections of open views but would revert to intermittent views comparable to the existing situation following the establishment of Proposed Scheme roadside vegetation.

12.10.4. The existing footbridge over the A47 connecting Cantley Lane and Cantley Lane South would be retained during the construction period. This would be replaced by a new overbridge which would be suitable for pedestrians, cyclists and equestrians. The new overbridge, which would carry Cringleford footpath FP4A,

would maintain crossing movements. Although it will result in a minor increase in journey times and lengths, the new overbridge will have a slight beneficial impact on WCHs. The Proposed Scheme would see the removal of Cringleford bridleway BR5 and the Pegasus crossing facilities.

12.10.5. Further work would be undertaken to develop design interventions to limit or reduce impacts and promote opportunities for the environment within the study area wherever possible. Design development and potential mitigation would be reported in the ES as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

13. People & communities – social

13.1. Introduction

13.1.1. This chapter sets out the baseline and assesses the preliminary impacts on People and Communities - Social arising from the A47/A11 Thickthorn Junction. This is a Design Manual for Road and Bridges (DMRB) topic and is covered in the Interim Advisory Note (IAN) 125/15 ('Environmental Assessment Update') and IAN 125/09 ('Supplementary Guidance for users of DMRB Volume 11 on Environmental Assessment'). The chapter describes the preliminary studies in relation to the Proposed Scheme and outlines proposed design and other measures to help mitigate these potential impacts.

13.2. Guidance and best practice

13.2.1. The chapter makes an assessment from a social perspective. The assessment is therefore in accordance with the relevant sections of DMRB Volume 11, Section 3, Part 6 (Land Use) (Highways Agency, 2001) and Part 8 (Pedestrians, Cyclists, Equestrians & Community Effects) (Highways Agency, 1993) which provide guidance on the sub-topics for People and Communities - social:

- demolition of private property and associated land take
- community land and community facilities
- community severance
- development land

13.2.2. People and communities is identified as a Design Manual for Roads and Bridges (DMRB) topic within Interim Advice Note (IAN) 125/15 (Highways England, 2015). People and communities is a broad topic and therefore, for ease of assessment and review, People and communities has been split into two chapters. Chapter 12 People and communities – travellers presents the assessment of the Proposed Scheme on the 'travellers' element (walkers, cyclists, horse riders and vehicle travellers) while this chapter presents assessment of the social elements of people, communities and local economy.

13.2.3. There is currently no DMRB guidance on the assessment of local and wider economic impacts. Potential Local Economy impacts, including economic development impacts as a result of the Proposed Scheme have been considered using a process based on the HM Treasury Green book principles (HM Treasury 2013). Local Economy is a sub-topic considered in this chapter in addition to the six detailed in the DMRB guidance.

13.2.4. These sub-topics form the foundation to the structure of this chapter. Due to the nature of each sub-topic having different requirements (such as different specialist inputs, study areas and assumptions and limitations), the headings in this chapter are sub-divided and grouped where relevant.

13.3. Study Area

Demolition of private property and land take, community land and community facilities, community severance, development land, and local economy

13.3.1. The land within the proposed site boundary is herein referred to as 'the Site'.

13.3.2. The area within 250m of the Site is referred to as the Local Impact Area (LIA) and is the primary study area for this topic. This LIA is used to assess: demolition of private property and associated land take; impacts on community land and community facilities; community severance; and impacts on development land.

13.3.3. The assessment of impacts on the local economy will focus on the Wider Impact Area (WIA) of South Norfolk District. Consideration will also be given to the wider area of the County of Norfolk where appropriate, particularly in the case of cumulative effects.

13.3.4. As the Proposed Scheme is one of three along the A47, the cumulative effects may be felt more widely than both the LIA and WIA and as such, the County of Norfolk is also considered.

Summary of the study areas:

13.3.5. For community sub-topics, the assessment covers a study area extending to a corridor of 250m from the land within the proposed site boundary (referred to hereafter as 'the Site'). However, in some instances, the assessment of community severance may extend beyond this to allow for consideration of the potential impacts of severance on communities, which extend beyond the study area. This is shown in Table 13.1 along with the other defined study areas.

Table **Error! No text of specified style in document.**1: People and Communities – Social study areas per sub- topic

Sub- topic	Study Area	Referred to as
Community land and community facilities Community severance Development land	250m from the Site	LIA
Local economy	South Norfolk District	WIA

13.4. Assumptions and Limitations

13.4.1. To prevent double- counting of impacts those impacts relating to other environmental topics (such as noise and air quality) are not considered in detail as part of the assessment.

13.4.2. The LIA is based on a 250m boundary from the Site, and not on distances via particular modes (such as walk times), by particular routes, or taking into account man-made and natural barriers (such as major roads, railway lines or water courses).

13.4.3. Potential impacts on human health are considered as part of those topics which are themselves determinants of health – namely noise, air quality, and, where relevant, within the People and communities – social chapter in the Environmental Statement (ES).

13.5. Baseline

Demolition of private property and associated land take

13.5.1. Residential commercial and agricultural property have been identified within the Site.

Community land, community facilities and community severance

13.5.2. Thickthorn park & ride station and car park falls within the LIA to the west of the junction. The station is accessed via the B1172. There are no other community facilities identified within the LIA.

13.5.3. Only a very small number of residential properties are located in the LIA. Land use is predominantly made up of the road network and commercial land. Located to the north west of the junction, on the B1172, there is one row of terraced and a pair of semi-detached properties. More properties are located slightly outside of the LIA within the WIA. A large housing estate called 'Round House Park' is just under 500m north east of the existing junction. Cringleford itself is also east of the junction (approximately 585m), where a large number of residential properties are also located.

13.5.4. There are several businesses located in the LIA. These are:

- McDonald's restaurant
- Shell petrol station
- Burger King restaurant
- Travelodge Norwich Cringleford hotel

- Leavers Driving Tuition driving school

13.5.5. The existing A47 route creates severance for walkers, cyclists and horse riders wishing to cross from one side to the other to access services. Currently there is a pedestrian bridge over the A47 located close to the top of Cantley Lane South within the LIA which helps to mitigate pedestrian severance. The footbridge currently helps to connect the Cantley Lane and Cantley Lane South for pedestrians and enables them to access to services in Cringleford such as the GP surgery.

13.5.6. There are two unnamed public rights of ways within the LIA. One is located south west of the main junction and linked to Cantley Lane South; the second one is located to the east of the main junction and links the A11 to Cantley Lane.

Development land

13.5.7. The Cringleford Neighbourhood Development Plan 2013-2026 shows that land within the LIA has been identified for future development. A large-scale planning application for approximately 650 residential properties, and other mixed-use development, is located directly to the east of the junction. The development is set to spread across two sites: one to the north of the A11, east of the A47 and west of Round House Way, the other to the south of the A11, east of the A47 and west of Cringleford.

13.5.8. The development plan shows permission has been approved for a drive-through restaurant with parking to be built on land at the Thickthorn roundabout. There is also set to be an expansion of Thickthorn park & ride.

Local economy

13.5.9. According to the 2017 Office for National Statistics (ONS) Mid-Year Population Estimates, South Norfolk has a population of 132,837, of whom 77,278 (58%) are of working age (16-64 years old). Children (aged under 16 years) make up 18% of the population, which is similar to the national average of 19%. Older people (over 65 years) comprise 24% of the general population, which is higher than the national average of 18%.

13.5.10. There are proportionally more economically active people in South Norfolk than in England (85% compared with 78%). Unemployment is lower in South Norfolk at 2% (compared to 5% in England and Wales).

13.5.11. The terms of deprivation, the Site is within the 20% least deprived neighbourhoods in England.

13.6. Consultation

13.6.1. Topic-specific consultation is not required for the assessment. However, where inputs from wider Proposed Scheme public consultation are relevant to the assessment, these will be incorporated.

13.7. Design interventions

13.7.1. A new overbridge serving walkers, cyclists and horse riders will be constructed across the A47 replacing the existing footbridge to ensure that there is no additional severance.

13.7.2. An important design intervention for the Proposed Scheme is to reduce the footprint as much as practicable, without adversely affecting the design. This reduces the total area of agricultural land affected as well as the number of incidents of farm access and irrigation severance. For this report it is too early in the design development to report on design interventions. Any relevant outcomes will be reported in the ES.

13.8. Potential mitigation measures

13.8.1. During construction, a Construction Environmental Management Plan (CEMP) should be prepared by the appointed contractor and implemented during construction. This would ensure construction is undertaken in as sensitive a manner as possible with regards to People and Community receptors. The CEMP should incorporate:

- a Community Relations Strategy, managing communication with both the general public and local businesses prior to and during all construction works
- the Considerate Constructors Scheme, informing local residents, businesses and other sections of the community about the Proposed Scheme
- guidance to minimise disturbance to local farm holdings and farm assets (for instance, livestock)
- a Traffic Management Plan (TMP), to manage all temporary diversions
- the construction of the new overbridge across the A47 and demolition of the old one should be phased to ensure that the new bridge is open before the old one is closed, minimising severance during construction

13.9. Potential impacts

Demolition of Private Property and Associated Land Take

13.9.1. The Proposed Scheme would require both temporary and permanent land take. The current design does not require demolition of buildings.

13.9.2. Temporary land take would be required to accommodate construction compounds. A main compound with a satellite compound would be required for the duration of the works. The location of the main compound is proposed to be to the west of the junction in an area of agricultural land south of the B1172 (OS 617825:305427). The satellite compound would be required to the east of the A47 close by to the main compound (Ordnance Survey (OS) 617985:305458). A system of temporary haul roads would be required to provide HGV access to each area of the works, which would also require land take. Temporary land take for construction compounds could result in adverse impacts for landowners.

13.9.3. The Proposed Scheme would require permanent land take within the LIA to accommodate the expansion of the junction during the construction stage. The operational phase would not require additional land take.

Community land and community facilities

13.9.4. Thickthorn park & ride would be affected as a result of the construction works. Access to this facility for its users and the route of the buses would be temporarily restricted.

13.9.5. Disruption to the local road network is likely to impact those accessing facilities in Cringleford (particularly those approaching Cringleford from the west). An increase in construction traffic, and possibly vehicles avoiding the junction during the construction period, may also impact such facilities. This is due to the possibility of an increase in noise levels and a heavier flow of traffic in an area used by pedestrians.

13.9.6. It is not anticipated that there will be any permanent impacts on community land and community facilities. This would be explored in the Environmental Impact Assessment (EIA).

Community severance

13.9.7. The reconfiguration of the local road network, as well as an increase in construction traffic, would cause temporary severance for users of Thickthorn park & ride during the construction period. The extent of any disruption for rail users is not known at present.

13.9.8. A pedestrian footbridge currently crosses the A47 close to the top of Cantley Lane South. This structure would be demolished, involving a temporary closure of the A47.

13.9.9. A new bridge would be constructed in proximity to Cantley Lane replacing the old footbridge to ensure there is no additional severance caused by removing the old bridge.

13.9.10. It is anticipated that works on Cantley Lane would involve a large amount of construction activity. The Proposed Scheme requires extensive cutting into the land. Users of Cantley Lane are therefore going to experience a considerable amount of temporary severance, and disruption due to the presence of construction vehicles. This has the potential to result in adverse impacts on users in this area.

13.9.11. The linking of Cantley Lane and Cantley Lane South could also create severance for the owner of the land between Cantley Lane South, the A47 and the Breckland Railway line and local residents. Alternative access has been considered as part of the Proposed Scheme design.

Development land

13.9.12. It is possible that the implementation of the Proposed Scheme may affect proposed future housing developments on adjacent land. Impacts on these sites will be assessed in full for the ES.

Local economy

13.9.13. The Proposed Scheme requires a construction workforce to deliver it, which will result in direct but temporary beneficial economic impact.

13.9.14. For the duration of the construction phase, there would be construction workers on-site. This has potential beneficial impacts on the local economy as a result of these workers using local hospitality and catering establishments.

13.9.15. Direct operational employment is not expected to be created as a result of the Proposed Scheme. However, there would be increased indirect employment opportunities related to reduced congestion and improved journey times.

13.10. Chapter summary

13.10.1. This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts associated with People and communities – social. Impacts are likely during both the construction and

operational phases as a result of temporary and operational land-take and severance.

13.10.2. Further work would be undertaken to develop design interventions to limit or reduce adverse impacts and promote opportunities for the environment in the study area wherever possible. Any design development and potential mitigation would be reported in the ES as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

14. Road drainage and water environment

14.1. Introduction

14.1.1. This chapter presents the preliminary findings of the road drainage and water environment assessment. This comprises a review of the existing environmental baseline information and identification of the potential impacts of the Proposed Scheme upon the water environment. The chapter also outlines proposed design measures to help mitigate potential impacts on the water environment and relevant consultation.

14.2. Guidance and best practice

14.2.1. The following legislation standard and best practice guidelines are relevant to the Proposed Scheme:

- National Planning Policy Framework and its associated Technical Guidance (Department for Communities and Local Government, 2019)
- Highways Act (1980)
- Highways (Environmental Impact Assessment) Regulations 2007 (EIA Highways Regulations 2007)
- Design Manual for Roads and Bridges (DMRB) Section 2: General Principles of Environmental Assessment (Highways Agency, 2008)
- Design Manual for Roads and Bridges (DMRB) Volume 11, Part 10 (HD 45/09) Road Drainage and Water Environment (Highways Agency, 2009)
- Directive 1991/676/EEC, more commonly known as the Nitrates Directive (1991)
- Directive 2000/60/EC, more commonly known as the Water Framework Directive (2000)
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
- The Groundwater (Water Framework Directive) (England) Direction 2016
- The Environment Agency's approach to groundwater protection (Environment Agency, 2017a)
- Best practice guidelines and procedures for pollution prevention and water management in construction as set out in the Construction Industry Research and Information Association (CIRIA) guidelines; CIRIA C532 (2002), CIRIA C648 (2006) and CIRIA C741 (2015).
- The Environmental Permitting (England and Wales) Regulations (2010) which replaces the Water Resources Act (1991) as the key legislation for water pollution in the UK.

- Environment Agency's environmental permitting guidance (Environment Agency, 2018c)
- Land Drainage Act 1991 and 1994
- Flood and Water Management Act (2010)
- The Environment Act (1995)
- The Water Act (2014)
- The Greater Norwich Development Partnership (2014) Joint Core Strategy for Broadland, Norwich and South Norfolk
- The South Norfolk Local Plan (2015-2026)
- The Norfolk Local Flood Risk Management Strategy (Norfolk County Council, 2015)

14.3. Study Area

14.3.1. The study area is inclusive of a 1km buffer (figure 14.1 in Appendix A) around the site. Additionally, the study area may be extended to include downstream water environment features beyond 1km if they are deemed to be at risk from either the construction or operation phases. The full extent of the study area will be confirmed as part of the Environmental Statement (ES) when further design details are available.

14.4. Assumptions and limitations

14.4.1. This chapter has been prepared using publicly available information, with reference to previous reports carried out at Highways England's Project Control Framework Stages 1 – 3 and the Highways Agency Drainage Data Management System (HADDMS). The assessment presented is based on a desk-based study.

14.4.2. Considering the nature of the Proposed Scheme, it is not considered that the data limitations introduce any uncertainties with respect to surface water, groundwater, and flood risk. A site visit will be carried out as part of the ES.

14.4.3. Construction methods are currently unknown and so the assumption has been made that construction will follow current best practice and guidelines.

14.5. Baseline

Local environment

14.5.1. The main water features within the study area are the catchments of two Water Framework Directive water bodies (The Yare and Intwood Stream). Both water bodies pass through the study area but outside the Site boundary, The Yare at

the far north-eastern extent and the Intwood Stream at the far eastern edge of the study area. Both water bodies are protected under the Nitrates Directive, and the entire study area is within the Yare Surface Water Nitrate Vulnerable Zone (NVZ) and the majority of the study area is also within the Norwich Crag and Gravels Groundwater NVZ.

14.5.2. An additional ordinary watercourse, hereafter known as Cantley Stream but also known as Thickthorn Stream, passes through the Site beneath both the A11 and A47 draining into the Intwood Stream catchment. A smaller unnamed ordinary watercourse located at the northern edge of the study area drains to the River Yare catchment.

14.5.3. There are a number of ponds in the vicinity of Cantley Stream both upstream and downstream of the Site that may constitute potential receptors of road run-off.

14.5.4. The majority of the study area is located within Flood Zone 1 which is associated with a low risk of flooding from fluvial and coastal sources. Where Cantley Stream passes beneath the A11 to the west there are localised areas of Flood Zone 2 and Flood Zone 3a. Beneath the A47 to the east, there are localised areas of Flood Zones 2 and 3b. There are no flood defences, areas benefitting from defences or flood storage areas with the study area (Environment Agency, 2017b).

14.5.5. The A47 carriageway is sufficiently raised above the floodplain and the Environment Agency's Flood Risk Map for Planning (Environment Agency, 2017b) shows the carriageway itself not to be at risk of flooding. The A11, however, is not raised sufficiently above the floodplain and the Environment Agency's Flood Risk Map for Planning does indicate the carriageway as being at risk from flooding.

14.5.6. There are localised areas of medium and high risk of surface water flooding, especially associated with the floodplains of Cantley Stream, the smaller watercourse to the north and on the A47 / A11 Thickthorn Junction (Environment Agency, 2017c).

14.5.7. According to HADDMS, road drainage within the study area comprises 19 soakaways and 22 outlets, none of which are considered high priority. The soakaways receive run-off from the A47 / A11 junction and the A47 between the roundabout and Cantley Stream. Six of the outlets drain the A11, and 16 of the outlets drain the A47, all discharging to Cantley Stream. The outlets and soakaways have a validation status of 'Confirmed' on HADDMS.

14.5.8. Based on the British Geological Survey Online Geology Maps (British Geological Survey, 2017), the study area is underlain by the Lewes Nodular Chalk

Formation overlain by superficial deposits, comprising Lowestoft Formation (Diamicton) and Sheringham Cliffs Formation Sand and Gravels. Cantley Stream is underlain by Alluvium.

14.5.9. According to the Environment Agency's online maps (Environment Agency, 2018b), the Lewes Nodular Chalk is classified as a Principal aquifer, and therefore has high storage capacity due to high intergranular and / or fracture permeability. It may support water supply and / or river base flow on a strategic scale. The Sheringham Cliffs Formation and Alluvium are classified as Secondary A aquifers, meaning they may support water supplies and baseflow at a local scale. The Lowestoft Formation (Diamicton) is classified as a Secondary (Undifferentiated) aquifer. It therefore likely has variable permeability in different locations.

Designated sites

14.5.10. There are no Ramsar sites, Special Areas of Conservation, Local Nature Reserves (LNR) or National Nature Reserves within the study area. Downstream and outside the study area, the River Yare is hydrologically linked to Eaton Common LNR and Marston Marshes LNR.

14.5.11. Lowland Fens, part of Natural England's Priority Habitat Inventory, are present along Cantley Stream to the east of the Scheme, underlain by alluvium.

Sensitive receptors

14.5.12. The Anglian River Basin District Management Plan (RBMP) provides information on three Water Framework Directive water bodies within the study area that have the potential to be affected:

- the Yare (Tiffey to Wensum water body reference: GB105034051281) surface water body which passes through the study area at the far north-eastern corner
- Intwood Stream (water body reference: GB105034051240) surface water body which passes through the study area at the south-eastern corner
- the Broadland Rivers Chalk and Crag groundwater body (water body reference: GB40501G40300), covers all groundwater within the study area.

14.5.13. The Yare water body (GB105034051281) passes through the study area at the far north-eastern corner and is designated as a Heavily Modified Water Body; lying within the Anglian River Basin District, the Broadland Rivers management catchment and the Yare operational catchment.

14.5.14. The Intwood Stream water body (GB105034051240) is classified as a Heavily Modified Water Body with 'Moderate' ecological potential and 'Good' chemical quality. The ecological potential is limited by physico-chemical quality elements (phosphate linked to the water industry and agriculture) not achieving 'Good' potential. The overall water body status is classified as 'Moderate' and is not expected to improve as it would be disproportionately expensive to do this.

14.5.15. Groundwater present within the study area is covered by the Broadland Rivers Chalk and Crag groundwater body (GB40501G40300). The quantitative status of this water body is limited by the Groundwater Dependent Terrestrial Ecosystems test which scored poorly due to agricultural abstractions lowering the natural flow and levels of the groundwater. The objective is to achieve 'Good' quantitative status by 2021. The chemical status is limited by the Chemical Drinking Water Protected Area criteria, which scored poorly although data is reportedly suspect. Objectives are to achieve 'Good' chemical status by 2027 by natural recovery. The water body is linked to the areas protected under the Nitrates Directive and Drinking Water Protected Areas highlighted above (Environment Agency, 2018a).

14.5.16. The study area is within the Norwich Crag and Gravels NVZ where directly underlain by Sheringham Cliffs Formation Sand and Gravels superficial deposits.

14.5.17. There are nine licensed groundwater abstractions, and two unlicensed abstractions, within the study area. There may be other unlicensed abstractions of less than 20m^3/day within the study area. Unlicensed abstraction information will be obtained from the local council after consultation.

14.5.18. The water receptors and their importance are defined in Table 14.1 and are based on the definitions provided in Table A4.3 of Annex IV in DMRB HD 45 / 09 (Highways Agency, 2009).

Table **Error! No text of specified style in document.**1: Identified sensitive water environment receptors

Receptor	Location	Importance
Broadland Rivers Chalk and Crag groundwater body [GB40501G400300]. This includes groundwater abstractions and groundwater fed surface water features as indirect receptors.	Underlies site and study area.	Very High
River Yare [GB105034051281]	Far north-eastern corner of the study area	Medium
Intwood Stream [GB105034051240]	Far south-eastern edge of the study area	Medium
Cantley Stream	Flowing eastwards under the A11 and A47 in the centre of the study area.	Medium

Receptor	Location	Importance
Unnamed watercourse	North of the study area 617367 306187	Low
Pond	616047 304310	Low
Pond	616705 303323	Low
Pond	616555 303736	Low
Pond	616346 304159	Low
Pond	617282 303985	Low
Pond	616908 304307	Low
Pond	617604 304984	Low
Pond	617503 305061	Low
Pond	617366 305225	Low
Pond	619246 304203	Low
Pond	618988 305691	Low

Baseline surveys

14.5.19. No water quality or other surveys were carried out for this chapter, and it is assumed that the information available on the water environment within the Anglian RBMP (Environment Agency, 2016) is representative of the general conditions at the Site location.

14.5.20. A water quality survey will be carried out to establish baseline conditions as part of the ES.

14.6. Consultation

14.6.1. No consultation has been carried out to establish baseline conditions as part of this preliminary assessment.

14.6.2. The following organisations with interest in road drainage and the water environment will be consulted during the statutory consultation period for the Proposed Scheme:

- Environment Agency
- Norfolk County Council as Lead Local Flood Authority
- Norfolk Rivers Internal Drainage Board
- South Norfolk District Council

- Anglian Water

14.7. Design Interventions

14.7.1. The Proposed Scheme would include areas of new carriageway and hardstanding. Some elements of this would discharge to existing drainage networks and subsequent outlets to Cantley Stream. A number of new surface water outlets are proposed which would discharge runoff to Cantley Stream via attenuation either through a pond to the west of the A11 or through oversized pipes. A pumping station would be required at the low point of the A11/A47 Junction to discharge via a rising main to the attenuation pond. In addition, a new soakaway will receive highway drainage from the A47 northbound successive diverge.

14.7.2. The impact of an increase in impermeable area as a result of the proposed carriageway and side roads, could result in an increase in peak flow rate and volume which could, in turn, increase flood risk. Appropriate attenuation would be required in the drainage design to ensure there is no increase in surface water run-off peak flow rate or volume as compared to the existing condition, including a 20% allowance for climate change. This mitigation may take the form of sustainable urban drainage systems (SuDS), where appropriate and subject to suitable ground conditions. Permanent SuDS features would be designed in accordance with relevant DMRB Standards (Highways England, 2016a; 2016b) and the SuDS Manual (CIRIA, 2015b).

14.7.3. Bypass interceptor drains may be used upstream of soakaways where required, to reduce the impact on groundwater quality from routine run-off and accidental spillages.

14.7.4. SuDS measures will be used, where appropriate, to mitigate the impact of routine run-off on the water quality of Cantley Stream.

14.7.5. The proposed new culvert, culvert extensions and diversion of Cantley Stream would be designed to minimise any impact, and where possible to provide a beneficial impact on flood risk, water quality, aquatic and riparian habitats and geomorphology.

14.7.6. Floodplain compensatory storage may be required due to the construction of the new Cantley Lane South access road and associated embankment in the floodplain of Cantley Stream.

14.7.7. Further design interventions may be required and identified during the design process and preparation of the ES when further details on the Proposed Scheme drainage are available.

14.8. Potential mitigation measures

14.8.1. During construction, best practice guidelines and procedures for pollution prevention and water management would be included as part of the overall Construction Environment Management Plant (CEMP). The CEMP will incorporate best practice as set out in Construction Industry Research and Information Association (CIRIA) guidelines CIRIA C532, (CIRIA, 2002); CIRIA C648, (CIRIA, 2006); and CIRIA C741, (CIRIA, 2015a) and Environment Agency Pollution Prevention Guidelines (Environment Agency, 2014); and the Environment Agency's approach to Groundwater Protection (Environment Agency, 2017a).

14.8.2. The potential for impacts to occur as a result of storage of materials would be minimised by locating compounds for the storage of construction materials or temporary stockpiling of excavation materials away from the surface watercourses and drains. Drums and barrels would be properly labelled and fitted with flow control taps and stored in a designated, bund safe area within the site compound.

14.8.3. Before any discharge of water is made from the site, appropriate settlement techniques would be used. All roads and hardstanding would be kept clean and tidy to prevent the build-up of pollutants, although the use of water sprays for reducing dust or washing construction areas would be carefully managed in order to avoid washing substantial quantities of silt etc. into surface water receptors. Where appropriate, watercourses would be shielded by bunds to prevent contamination from surface water runoff.

14.8.4. The potential for impacts to occur as a result of contamination from accidental spillage would be minimised by the inclusion of emergency response procedures in the CEMP to handle any leakage or spillage of potentially contaminating substances. Spill kits would be located on site near to watercourses and within the works compounds and staff will be trained in their use.

14.8.5. It is assumed that temporary watercourse crossings during construction would be required as part of the Proposed Scheme. These should be designed to minimise impact on flood risk and water quality.

14.8.6. Further mitigation measures may be required and identified during the preparation of the ES when further details on the Proposed Scheme drainage are available.

14.9. Potential impacts

Construction

14.9.1. The potential impacts of the Proposed Scheme during construction include the following:

- damage to aquatic ecosystem of unnamed ponds, Cantley Stream and the unnamed Ordinary watercourse, and quality impacts on abstractions, due to pollution of watercourses and Broadland Rivers Chalk and Crag groundwater body from mobilised suspended solids, heavy metal contamination and spillage of fuel, oil, concrete or cement products
- increased risk of flooding due to changes in the extent of the floodplain of Cantley Stream or changed / new flood pathways due to temporary barriers created by construction works, for example, topsoil stockpiles
- temporary impacts on local structures, including property and infrastructure, due to subsidence arising from changes in groundwater level, for example due to dewatering or pilling. Dewatering may impact on groundwater available for local abstractions, if occurring within the radius of influence
- foundations and piles providing potential pathways for contaminant migration and localised barriers to groundwater flow in Broadland Rivers Chalk and Crag groundwater body. This may also impact on the groundwater available for abstractions or groundwater fed surface water features

14.9.2. Further potential construction impacts may be identified during the preparation of the ES when further details on the Proposed Scheme drainage are available.

Operation

14.9.3. The potential impacts of the Proposed Scheme during the operation phase include:

- potential increase in the rate of run-off and flood risk from an increase in impermeable area contributing flow to outlets to Cantley Stream and unnamed Ordinary watercourse
- pollution of Broadland Rivers Chalk and Crag groundwater body or surface water features (ponds and watercourses) associated with routine road run-off. This risk is likely to increase with the potential increase in the volume of traffic
- risk of pollution to Broadland Rivers Chalk and Crag groundwater body or surface water features (ponds and watercourses) resulting from accidental spillages or pollution incidents. This risk is likely to increase with the potential increase in the volume of traffic

- potential impacts on the aquatic and riparian habitats and geomorphology of Cantley Stream as a result of culverting and diversion.
- potential impact on flood risk due to a proposed culvert, culvert extension and the construction of the Cantley Lane South access road embankment in the Cantley Stream floodplain in Flood Zone 3
- changes to land drainage, surface water run-off and associated flood risk
- foundation and piles providing localised barriers to groundwater flow. This may impact on groundwater available in the Broadland Rivers Chalk and Crag groundwater body

14.9.4. Further operational impacts may be identified during the preparation of the ES when further details on the Proposed Scheme drainage are available.

14.10. Chapter summary

14.10.1. This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon road drainage and water environment. Impacts may occur during the construction and operation phases, and impact on surface water and groundwater receptors. These comprise Cantley Stream and its floodplain, the unnamed Ordinary watercourse, a number of unnamed ponds within the study area, and the Broadland Rivers Chalk and Crag groundwater body and associated abstractions.

14.10.2. Impacts during construction would associate with accidental spillage of construction materials, earthworks, dewatering, piling and foundation construction, and changes to the Cantley Stream floodplain.

14.10.3. Impacts during operation would associate with road drainage discharges of routine road run-off and accidental spillages to both ground and surface water receptors, culverting and diversion of Cantley Stream, changes to Cantley Stream floodplain and land drainage, and road foundations and piling.

14.10.4. Further work would be undertaken to develop design interventions to limit or reduce adverse impacts and promote opportunities for the environment in the study area wherever possible. Design development and potential mitigation would be reported in the ES as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

15. Climate

15.1. Introduction

15.1.1. This chapter presents the preliminary findings of the Climate assessment. This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme in the context of climate. The chapter also outlines proposed design measures to help mitigate potential impacts and relevant consultation.

15.2. Guidance and best practice

15.2.1. The Climate Change Act (2008) sets out legally binding targets for reducing the UK's carbon emissions by 80% by 2050, relative to a 1990 baseline. The Environmental Impact Assessment (EIA) Directive (2014/52/EU) and subsequent updates to UK EIA regulations also now include a requirement to assess the impacts of projects on climate and their vulnerability to climate change.

15.2.2. To align with the requirements of the Infrastructure Planning EIA Regulations 2017, the National Networks National Policy Statement (NNNPS) 2014 and the recently updated Highways England Major Projects' Instructions, the chapter covers two separate aspects:

- Effects on Climate – for example potential impacts on climate from carbon emissions arising from the Proposed Scheme, including how the project may affect the ability of Government to meet its carbon reduction targets (in accordance with NNNPS paragraph 5.17).
- Vulnerability of the Proposed Scheme to climate change – for example the resilience of the Proposed Scheme to climate change impacts, including how the Scheme will take account of the projected impacts of climate change (in accordance with NNNPS paragraph 4.40 and the IP EIA Regulations 2017).

15.2.3. For the purposes of this report, the term 'carbon' will be used as shorthand to refer to all relevant Greenhouse Gas (GHG) emissions.

15.2.4. The following guidance documents have also been used to inform the assessment:

- Highways England Major Projects' Instructions (MPI-57-052017, Rev 1) 'Environmental Impact Assessment: Implementing the Requirements of 2011/92/EU as amended by 2014/52/EU (EIA Directive)'
- Climate Adaptation Risk Assessment Progress Update (Highways England, 2016)

- IEMA Environmental Impact Assessment guide to Climate Change Resilience and Adaptation (IEMA, 2015)
- IEMA's Guidance on Assessing the GHG Emissions and Evaluating their Significance (IEMA, 2017)
- Transport Analysis Guidance (TAG) Unit A3 Environmental Impact Appraisal (Department for Transport (DfT), 2015) Chapter 4 Greenhouse Gases
- Publicly Available Specification (PAS) 2080:2016 Carbon Management in Infrastructure (British Standards Institution, 2016)

15.3. Study area

Effects on Climate

15.3.1. The carbon emissions impact assessment considers the carbon emission potential of the Proposed Scheme for both construction and operation (for this assessment the operation will be considered for the design life of the Proposed Scheme).

15.3.2. In the subsequent Environmental Statement (ES), capital (embodied) carbon emissions associated with Proposed Scheme construction would encompass material supply, transport and manufacturing where practicable, as well as fuel associated with construction plant.

15.3.3. Operational carbon emissions associated with end-users of the Proposed Scheme (i.e. vehicle tailpipe emissions) will be assessed and reported in line with DMRB Volume 11 Section 3 Part 1 (HA 207/07).

15.3.4. In accordance with Highways England Major Projects' Instruction (MPI 57-052017, Rev 1), emissions associated with the end of life stage (i.e. decommissioning) will not be reported due to the uncertainty associated with the length of operation (use stage).

Vulnerability of the Proposed Scheme to climate change

15.3.5. For the purposes of the resilience assessment, the study area has been defined as follows in accordance with Highways England Major Projects' Instruction (MPI 57-052017, Rev 1):

- The area of temporary and completed work within the project boundary affected receptors identified within other environmental factors scoped into the assessment (reported within the relevant optic text within the cumulative assessment, where applicable).

15.3.6. The vulnerability of the Proposed Scheme to climate change during both construction and operation will be considered, the latter of which is informed by the design life of the Proposed Scheme and the availability of UK Climate Projections.

15.3.7. For the purposes of assessing the climate baseline and future climate projections, regional historic data from the Met Office (2016) and the UK Climate Projections (2009) have been used.

15.4. Assumptions and limitations

15.4.1. Data pertaining to the climate baseline and future projections are based on available information from third parties, including the historical meteorological variables recorded by the Met Office and the UK Climate Projections (UKCP09) developed by the Met Office.

15.4.2. Uncertainty is inherently associated with climate change projections, as they are complex in nature and based upon various assumptions including future global emissions trajectories. The level of uncertainty associated with projections also varies between climate variables. For example, projections related to wind and extreme weather events are considered more uncertain than those pertaining to temperature and precipitation. Similarly, the degree of uncertainty associated with all climate change projections increases with time.

15.5. Baseline

Effects on climate

15.5.1. The carbon baseline has been taken as the current situation in which no proposed infrastructure is built and considers existing travel and traffic patterns.

15.5.2. The availability of carbon baseline data specific to the study area is currently limited, therefore existing carbon emissions have been considered from a variety of sources (e.g. published local authority data) in the proximity of the Proposed Scheme.

15.5.3. Most recent figures, released in 2015, indicated total transport emissions for the wider Norfolk County area to be approximately 1,953,000 tonnes of CO_2 (Department for Business, Energy & Industrial Strategy, 2017a).

15.5.4. In 2015, 24% of UK greenhouse gas emissions originated from the transport sector with emissions of 120 $MtCO_2e$. The transport sector remains a key contributor to projected UK carbon emissions increases with road transport emissions projected to rise by 28 $MtCO_2e$ (6%) over 2023-2027 (the fourth

carbon budget period), relative to 2015 projections (Department for Business, Energy & Industrial Strategy, 2017b).

Vulnerability of the proposed scheme to climate change

15.5.5. A current climate baseline for the wider region has been compiled using Met Office (2016) regional climate data for the Eastern England region. High-level climate observations for the region over a 30-year averaging period (1981-2010) are presented in Table 15.1.

Table **Error! No text of specified style in document.**1: Historic climate baseline for Eastern England

Climate variables	Climate Observations
Temperature	Mean daily minimum temperatures can range from 0°C to 2°C in winter, whilst summer daily maximum temperatures are in the region of 22°C.
Rainfall	Eastern England includes some of the driest areas in the country, with the majority of the region receiving less than 700mm of rainfall annually, distributed fairly evenly throughout the year. On average, the region experiences approximately 30 rain days during the winter months (December – February) and under 25 days during the summer period (June – August). Despite generally low levels of precipitation, the area has encountered a number of severe storms which can contribute significantly to total annual rainfall and may also result in the occurrence of hail.
Wind	Eastern England is one of the more sheltered parts of the UK, however the winter months are when the strongest winds are experienced. Wind direction is fairly consistent across the region; speeds are generally greater in coastal locations than inland, and gusts exceeding 167 km/h have been recorded in East Anglia. The frequency of tornadoes is greatest in eastern England relative to other parts of the UK, nevertheless, the intensity of these events remains minor.
Sunshine	Average annual sunshine in the wider region ranges from approximately 1450 hours over Lincolnshire and East Yorkshire, to over 1600 hours in east Norfolk, Suffolk and Essex.
Air Frost	The average number of days with air frost ranges from less than 30 (coastal) to 55 (inland) per year.

Source: Met Office (2016) Regional Climate Data

Future projections

15.5.6. The UK Climate Projections (UKCP09) provide regional climate projection information, for which the Site is included within the East of England Administrative Region. The East of England region is predicted to experience changes in temperature, rainfall, and frequency of extreme weather events as a consequence of climate change. These changes are predicted to occur under all three carbon emissions scenarios (i.e. low, medium and high), which are incorporated into the climate change models prepared by the Met Office Hadley Centre. The general trend for the region is warmer, drier summers and warmer, wetter winters.

15.5.7. Under the high emissions scenario (50% probability) projection for the 2080s, estimated changes in climatic conditions are as outlined in Table 15.2.

Table **Error! No text of specified style in document.**2: Future climate projection data for East of England (2080s; high emissions scenario)

Climate variables	Climate Observations
Temperature	The average summer temperature is projected to increase by 4.5°C under the central estimate, which represents 'as likely as not' probability of change (50th percentile), and average winter temperature is estimated to increase by 3.7°C (50th percentile).
Rainfall	The average summer rainfall rate is projected to decrease by 27%, whereas the average winter rainfall rate is estimated to increase by 26% (in the 50th percentile or central estimate for both).
Wind	Climate projections for wind are more uncertain than those for temperature and precipitation, due to inherent difficulty in modelling future wind conditions. However, overall an increase in extreme weather including wind is projected (Committee on Climate Change, 2017).

Source: UKCP09 UK Climate Projections

15.5.8. Climate projection data corresponding to the 2080s (2070-2099) under a high emissions scenario as per NNNPS guidance. That is, transport infrastructure with safety-critical elements and the design life of the asset is 60 years or greater, and therefore applicable to the Proposed Scheme.

15.6. Consultation

15.6.1. No external consultation has been undertaken for the assessment at this stage. This would be undertaken, where necessary, as part of the ES. Consultation with the Proposed Scheme design team and environmental specialists is currently on-going and outcomes would be reported within the ES.

15.7. Design interventions

15.7.1. Under the current proposals, a 20% climate change allowance has been utilised for the drainage design for Proposed Scheme. For the proposed attenuation pond, a 40% climate change allowance has been utilised.

15.8. Potential mitigation measures

Effects on climate

15.8.1. In accordance with Highways England Major Projects' Instruction (MPI 57-052017, Rev 1), projects shall seek to minimise emissions as far as practicable in all cases in order to contribute to the UK's net reduction in carbon emissions. Mitigation of effects on climate (i.e. carbon emissions associated with the Proposed Scheme) will primarily take place throughout the design process in

accordance with the principles of PAS 2080 (Carbon Management in Infrastructure). Details of any mitigation measures relevant to climate will be reported in the subsequent ES.

15.8.2. The duration of the construction works for the Proposed Scheme is anticipated to be approximately 16 months. As outlined in the Air Quality and Materials chapters, measures to be included in the Construction Environmental Management Plan (CEMP) would serve to limit emissions. This mitigation could include the following:

- reduction of raw material usage and recycling
- use of local suppliers
- ensuring vehicle engines and plant motors are switched off when not in use

15.8.3. Further assessment of the carbon emissions associated with the Proposed Scheme and potential mitigation measures would be reported in the ES.

Vulnerability of the proposed scheme to climate change

15.8.4. The Site may be subject to weather extremes during construction, although it is not anticipated that verifiable climate change would occur in the timeline between the time of design and environmental assessment, and the end of the construction period. Construction works are not considered to be vulnerable to climate change, therefore no associated mitigation, other than what would be reasonable site practice at the time of design finalisation, is considered to be necessary.

15.8.5. Operational climate mitigation measures would be outlined in the ES.

15.9. Potential impacts

Effects on climate

15.9.1. Potential impacts related to emissions generated during Proposed Scheme construction and operation phases are detailed in Table 15.3. An appraisal of carbon emissions arising from the Proposed Scheme would be carried out and reported in the ES.

Table **Error! No text of specified style in document.**3: Potential impacts to climate

Effects on climate	
Construction	The average summer temperature is projected to increase by 4.5°C under the central estimate, which represents 'as likely as not' probability of change (50th percentile), and average winter temperature is estimated to increase by 3.7°C (50th percentile).

Operation	The average summer rainfall rate is projected to decrease by 27%, whereas the average winter rainfall rate is estimated to increase by 26% (in the 50th percentile or central estimate for both).
Vulnerability of the proposed scheme to climate change	
Construction	Climate change is not expected to affect Proposed Scheme construction and has been scoped out of the resilience assessment.
Operation	Changes in climate as outlined in Table 15.2 are anticipated over the design life of the Proposed Scheme. This has the potential to pose a risk to Proposed Scheme assets.

15.10. Chapter summary

15.10.1. The Proposed Scheme is anticipated to generate an increase in carbon emissions during both construction and operation. Changes in climate have the potential to impact Proposed Scheme assets and environmental receptors during operation. Predicted changes in climate have the potential to pose a risk to the Proposed Scheme.

15.10.2. Further work would be undertaken to develop design interventions to limit or reduce adverse impacts and promote opportunities for the environment in the study area wherever possible. Any design development and potential mitigation would be reported in the ES as well as further detailing of baseline conditions and climate change resilience.

16. Combined and cumulative impacts

16.1. Introduction

16.1.1. Combined and cumulative impacts result from multiple actions on receptors over time and are generally additive or interactive (synergistic) in nature. They can also be considered as effects resulting from incremental changes caused by other past, present or reasonably foreseeable actions together with the project, identified as:

- Combined effects from a single project (the interrelationship between different environmental factors)
- Cumulative effects from different projects (with the project being assessed)

16.2. Legislation and guidance

16.2.1. The following legislation, standards and best practice guidelines are considered relevant to the Proposed Scheme with regard to combined and cumulative impacts and will be reported in the Environmental Statement (ES) as such;

- The Town and Country Planning (Environmental Impact Assessment) Regulations 2017
- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 5 Assessment and Management of Environmental Effects
- The Planning Inspectorate Advice Note Seventeen: Cumulative Effects Assessment

16.3. Consultation

16.3.1. Consultation with South Norfolk Council as the Local Planning Authority will be undertaken in advance of the production of the ES to agree a list of proposed developments to be included within the cumulative impacts assessment.

16.4. Study area

Combined impacts

16.4.1. The study area for the assessment of combined impacts, for both construction and operation, are defined by the study areas identified within the relevant environment topic chapters of this Preliminary Environmental Information Report (PEIR).

Cumulative

16.4.2. The search area for the identification of 'other developments' for inclusion in the assessment of cumulative effects will reflect a 2km Zone of Influence (ZOI) around the boundary of the Proposed Scheme, for both construction and operation. This 2km ZOI is large enough to cover the proposed developments likely to contribute to cumulative impacts, whilst being proportionate to the scope and scale of the Proposed Scheme. DMRB Volume 11, Section 2, Part 5, details the study area for the assessment of cumulative impacts should be defined on a case-by-case basis reflecting the Proposed Scheme in question and the area over which impacts can reasonably be considered to have the potential to occur from both the Proposed Scheme and in combination with other developments. As such, a 2km search area is deemed appropriate for the Proposed Scheme.

16.5. Combined and cumulative impacts

16.5.1. The likely residual impacts and proposed mitigation for combined cross-discipline impacts and potential cumulative impacted from other developments will be identified and incorporated into the cumulative impacts assessment of the ES.

16.6. Chapter summary

16.6.1. The chapter of the ES will bring together the principal findings of each topic chapters in order to identify and assess the combined and cumulative impacts of the Proposed Scheme in association with other existing or future developments within the study area.

17. Glossary

Acronym	Description
AADT	Annual Average Daily Traffic
ALC	Agricultural Land Classification
AOD	above ordnance datum
AONB	Area of Outstanding Natural Beauty
AQIA	Air quality impact assessment
AQMA	Air Quality Management Area
AQO	Air Quality Objectives
ARN	Affected Road Network
BAP	Biodiversity Action Plan
BGS	British Geological Survey
BMV	Best and Most Versatile Land
BoCC	Birds of Conservation Concern
BS	British Standard
c.	circa
CCI	Community Conservation Index
CEMP	Construction Environmental Mitigation Plan
CIRIA	Construction Industry Research and Information Association
CL:AIRE	Contaminated Land: Applications in Real Environments
CO_2	Carbon Dioxide
CRTN	Calculation of Road Traffic Noise
CWS	County Wildlife Site
CZ	Consultation Zone
DAFOR	Scale: Dominant, Abundant, Frequent, Occasional, Rare
DCLG	*(former)* Department for Communities and Local Government
DCO	Development Consent Order
DEFRA	Department for the Environment, Food and Rural Affairs
dB	Decibel
DfT	Department for Transport

Acronym	Description
DMRB	Design Manual for Roads and Bridges
DMV	Deserted Medieval Village
EAR	Environmental Assessment Report
EcIA	Ecological Impact Assessment
ECoW	Ecological Clerk of Works
eDNA	Environmental DNA
EIA	Environmental Impact Assessment
ES	Environmental Statement
EU	European Union
GCN	Great Crested Newt
GHG	Greenhouse Gas
GI	Ground Investigation
GIS	Geographic Information System
GP	General Practitioner
GPA	Good Practice Advice
GVA	Gross Value Added
HADDMS	Highways Agency Drainage Data Management System
HDV	Heavy Duty Vehicle
HAGDMS	HAGDMS – Highways Agency Geotechnical Data Management System
HER	Historic Environment Records
HGV	Heavy Goods Vehicle
HRA	Habitats Regulations Assessment
HSI	Habitat Suitability Index
IAN	Interim Advice Note
IT	Interim Target
Km	kilometre
Kph	Kilometres per hour
LED	Light Emitting Diode
LCA	Landscape Character Areas

Acronym	Description
LIA	Local Impact Area
LLFA	Lead Local Flood Authority
LNR	Local Nature Reserve
LSOA	Lower Super Output Area
LUC	Land Use Consultants
LVIA	Landscape and Visual Impact Assessment
LWS	Local Wildlife Site
m	metre
MHCLG	*(former)* Ministry of Housing, Communities and Local Government
MMP	Materials Management Plan
MPI	Major Projects Instruction
MT	Motorised Travellers
$MtCO_2e$	Metric tons of carbon dioxide equivalent
NBIS	Norfolk Biodiversity Information Service
NCA	National Character Area
NERC	Natural Environment and Rural Communities
NHLE	National Heritage List for England
NIA	Noise Important Area
WCH	Walkers, Cyclists and Horse Riders
NNR	National Nature Reserves
NNNPS	National Networks National Policy Statement
NO_2	Nitrogen dioxide
NO_X	Nitrogen Oxides
NSIP	Nationally Significant Infrastructure Project
NVZ	Nitrate Vulnerable Zone
ONS	Office for National Statistic
OS	Ordnance Survey
PA	Planning Act
PAS	Publically Available Specification

Acronym	Description
PCM	Pollution Climate Mapping
PEI	Preliminary Environmental Information
PEIR	Preliminary Environmental Information Report
PIE	Public Information Event
PINS	The Planning Inspectorate
PPE	Personal Protective Equipment
PRF	Preliminary Roost Feature
PRoW	Public Right of Way
RBMP	River Basin Management Plan
RIS	Road Investment Strategy
RNR	Roadside Nature Reserve
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SEB	Statutory Environmental Bodies
SoCC	Statement of Community Consultation
SPA	Special Protected Area
SSSI	Site of Special Scientific Interest
SuDS	sustainable urban drainage systems
TAG	Transport Analysis Guidance
TEAM	Transparent Economic Assessment Model
TMP	Traffic Management Plan
µg/m$_3$	Microgram per metre cubed
UK	United Kingdom
UKCP	United Kingdom Climate Projections
VP	Vantage Point
WFD	Water Framework Directive
WHO	World Health Organization
WIA	Wider Impact Area
ZOI	Zone of Influence

Acronym	Description
Definitions	
Term	**Description**
Air quality limit value	A level fixed on the basis of scientific knowledge, with the aim of avoiding, preventing or reducing harmful effects on human health and/or the environment as a whole, to be attained within a given period.
Air Quality Management Area	An area identified by a local authority where the local air quality objectives not being achieved, or are not likely to be achieved within the relevant period. As required by Part IV of the Environment Act 1995.
Air quality objectives	Ambient concentration not to be exceeded, either without exception or with a permitted number of exceedances, within a specified timescale
Air Quality Strategy	The Government's air quality policy document for England, Scotland, Wales and Northern Ireland
Ambient concentration	Concentration of a pollutant in the surrounding area of environment
Artefact	An item of archaeological interest
Averaging period	A period of time over which a concentration is averaged when reporting air quality statistics. Commonly used averaging periods are 1-hour, 24-hour, 30-days and 365-days (annual). The averaging periods available for use is determined by the measurement technique employed for a given pollutant.
A-weighting	A standard filter applied to acoustic pressure fluctuations to compensate for the relatively low sensitivity of human ears to low and high frequencies
Bronze Age	The period of human activity between 2,500 BC and 700 BC
Continuous monitoring	The measurement of a pollutant concentration using an electronic instrumentation continuously over time. The time interval for each measurement is very short which allows rapid changes to be recorded. These measurements can be aggregated in to longer period averages of 1-hour, 8-hour etc.
Cutting	The removal of soil or rock material to reduce the profile or elevation of the topography of a site.
Data capture rate	The quantity of actual data collected over a specified period as a percentage of the theoretical maximum available
Diffusion tube	Simple monitoring device for air pollutants that absorbs substances from the air by diffusion (e.g. nitrogen dioxide) into a liquid film coated onto the inside of a plastic tube.
dB	A logarithmic scale that is used for sound pressure levels. Typically, a quiet night-time level in a bedroom is 30dB and 90dB is the level at the kerbside of a busy road
Earthworks	The moving of soil or rock to reconfigure the topography of a site.
Embodied Carbon	The amount of carbon released from material extraction, transport, manufacturing and related activities. This may be calculated from cradle to (factory) gate, cradle to (installation) site or from cradle to grave (final point of disposal).
Exceedance	Infringement environmental protection standards by exceeding allowable limits or concentration levels.
Fieldwalking survey	Method of systematic non-intrusive survey involving walking across a plough field along transects to collect archaeological artefacts

Acronym	Description
Geophysical survey	Method of non-intrusive investigation involving the use of magnetometers to identify fluctuations in the earth's magnetic field which might indicate the presence of archaeological remains. Burnt remains and metals are best identified through this method of survey.
Heritage asset	An item of heritage interest, for example an historic building or an archaeological find.
Iron Age	The period of human activity between 700 BC and 43 AD
LA10,18h	The A-weighted sound level in dB that is exceeded 10% of the measurement period and is the standard index used within the UK to describe daytime traffic noise
LAeq,T	The A-weighted steady sound level over time interval T that has the same mean square pressure as the time varying noise over the same time interval
LiDAR	Light Detection and Ranging. A remote sensing operation using data taken from the air to identify changes in the landform.
Lnight	The equivalent continuous sound level which has the same A-weighted mean square pressure as the time varying noise between 23:00 and 07:00
Made Ground	Ground created by infilling an area with material taken from elsewhere; typically, reworked soils, rubble, gravel, sand or former waste material e.g. ash.
MMP (Materials Management Plan)	MMP - Materials Management Plan; The MMP documents how all of the materials to be excavated are to be dealt with.
Medieval	The period of human activity between 1066 AD and 1550 AD
Mesolithic	Middle Stone Age. The period of human activity between 10,000 BC and 4,500 BC.
Metal detector survey	Method of intrusive investigation involving the use of metal detectors to locate buried metal objects.
Modern	The period of human activity from 1900 to the present day
National Mapping Programme (NMP)	A project funded by Historic England and local councils involving assessment and interpretation of aerial photographs and other remote sensing data, such as LiDAR.
Neolithic	New Stone Age. The period of human activity between 4,500 BC and 2,500 BC
NERC S41	Section 41 of the Natural Environment and Rural Communities Act 2006
Nitrogen oxides (NOx)	Nitrogen oxides is a term used to describe a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2), referred to collectively as NOx. These are primarily formed from atmospheric and fuel nitrogen as a result of high temperature combustion. The most important sources in the UK are road traffic and power generation
Palaeolithic	Old Stone Age. The period of human activity before around 10,000 BC
Post-medieval	The period of human activity between 1550 AD and 1900 AD
PM10	Particulate Matter less than 10 microns, tiny solid or liquid particles of soot, dust, smoke, fumes, and aerosols. The size of the particles (10 microns or smaller, about 0.0004 inches or less) allows them to easily enter the air sacs in the lungs where they may be deposited, resulting in adverse health effects
Prehistoric	The period before the year 43 AD

Acronym	Description
Roman	The period of human activity between 43 AD and 410 AD
Saxon	The period of human activity between 410 AD and 1066 AD
SRP	Soil Resource Plan; part of the Code of Practice for the Sustainable Use of Soils on Construction Sites used to protect soils and ensure adequate soil function (e.g. plant growth, water attenuation, biodiversity) during and after construction.
Site Waste Management Plan (SWMP)	A plan which specifies how waste generated throughout the construction works will be managed and volumes estimated. This includes minimisation, storage, segregation, re-use and final disposal of wastes generated.

18. References

Air Quality

Department for Environment Food and Rural Affairs, July 2007, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Cm 7169

Department for Environment Food and Rural Affairs, 2017, UKL Plan for tackling roadside nitrogen dioxide concentrations

Department for Environment Food and Rural Affairs, 2016 Local Air Quality Management – Technical Guidance 2016

Department for Transport, 2015, National Policy Statement for National Networks NPSNN

European Commission, 2008, Directive 2008/50/EC on ambient air quality and cleaner air for Europe

Highways Agency, 2007, Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1, HA 207/07, Air Quality

Highways Agency, 2012, Interim Advice Note 170/12 Updated air quality advice on the assessment of future NOx and NO_2 projections for users of DMRB Volume 11 Section 3. Part 1 Air Quality

Highways Agency, 2013, Interim Advice Note 174/13 Updating advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 Air Quality

Highways Agency, 2013, Interim Advice Note 175/13 Updated air quality advice on risk assessment related to compliance with the EU Directive in ambient air quality and on the production of Scheme Air Quality Actions Plans for user of DMRB Volume 11, Section 3 Part 1 Air Quality

Highways England, 2015, Interim Advice Note 185/15 Updated traffic, air quality and noise advice on the assessment of link speeds and generation of vehicle data into 'speed-bands' for users of DMRB Volume 11m Section 3, Part 1 Air Quality and Volume 11 Section 3 Part 7 Noise

Statutory Instrument, 2002, The Air Quality (England) (Amendment) Regulations 2002, No. 3043

Cultural Heritage

Archaeological Services WYAS 2013 Land at Cringleford, Norfolk: Geophysical Survey Report number 2489

Archaeological Services WYAS 2018 A47/A11 Thickthorn Junction, Hethersett, Norfolk, ENF143424; geophysical survey Report No. 3121

Cranfield Soil and Agrifood Institute Soilscapes http://www.landis.org.uk/soilscapes/ (last accessed 09/11/17)

NERC (2017) British Geological Survey [online] available at: http://www.bgs.ac.uk/ (last accessed October 2017)

Norfolk Landscape Archaeology 2009 Norfolk's Historic Landscape Character: A report on the Norfolk Historic Landscape Characterisation (HLC) Project

Northamptonshire Archaeology 2011 Archaeological fieldwalking and geophysical survey on land north of Hethersett Norfolk

Landscape

Landscape Institute & Institute of Environmental Management and Assessment. (2013). Guidelines for Landscape and Visual Impact Assessment Third Edition. Routledge

Highways Agency (1993). Design Manual for Roads and Bridges Volume 11 Section 3 Part 5 Landscape Effects.

Highways Agency (2010). Design Manual for Roads and Bridges Interim Advice Note 135/10 (IAN 135/10) Landscape and Visual Effects Assessment.

Tudor, C. (2014). An Approach to Landscape Character Assessment. Natural England and Department for Environment, Food and Rural Affairs

South Norfolk Council. (2015). *South Norfolk Local Plan Development Management Policies Document Adopted Version*. South Norfolk Council.

Biodiversity

All UK (and individual UK countries) legislation can be viewed at: http://www.legislation.gov.uk/browse, accessed May 2017

BAT CONSERVATION TRUST, Bats and Buildings

BIBBY, CJ ET AL, Bird census techniques (2nd edition), 2007, Academic press

BRITISH STANDARDS INSTITUTE, Surveying for Bats in Trees and Woodland – Guide (BS 8596:2015) (1st edition)

Brown, A.F. & Shepherd, K.B. (1993) A method for censusing upland breeding waders. Bird Study 40, 189-195

Byfield, A.J. & Wilson, P.J. (2005) Important Arable Plant Areas: identifying priority sites for arable plant conservation in the United Kingdom. Plantlife International, Salisbury

CHANIN P, Ecology of the European Otter, 2003

Collins (2016). Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition)

DEAN, M ET AL, The Water Vole Mitigation Handbook (The Mammal Society Guidance Series), 2016

Defra (2007) Hedgerow Survey Handbook – a Standard Procedure for Local Surveys in the UK. Countryside Council for Wales, Bangor

ENGLISH NATURE, Great Crested Newt Mitigation Guidelines, 2001

Geology and Soils

A47-A12 Schemes, Thickthorn Junction Improvements Preliminary Sources Study Report (PSSR) (Document Ref: HE551492-ACM-HGT-TJRP-CE-00001) (HAGDMS:29915)

Envirocheck Report (Landmark, 2017)

Unexploded ordnance preliminary threat assessment (HAGDMS:29967)

Technical Note for Ground Investigation – Cantley Lane Landfill (HETTNJCT-MMSJV-EHR-000-CO-LH-00002)

Materials

Highways Agency, 2008. DMRB Volume 11, Section 2, Part 5 Assessment and Management of Environmental Effects (HD 205/08)

Highways Agency, 2011 - IAN 153/11 Guidance on the Environmental Assessment of Material Resources

Noise and Vibration

The National Planning Policy Framework, 2019

The Noise Policy Statement for England, 2010

Planning Practice Guidance (noise), 2014

The Draft National Policy Statement for National Networks, 2013

The Land Compensation Act 1973 Part 1, 1973

Statutory Instrument 1763, The Noise Insulation Regulations 1975, as amended 1988

The Control of Pollution Act, 1974

British Standard (BS) 5228-1:2009+A1:2014, Code of practice for noise and vibration control on construction and open sites – Part 1: Noise, 2014

BS5228-2:2009+A1:2014, Code of construction practice for noise and vibration control on construction and open sites - Part 2: Vibration, 2014

Highways Agency Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 7, Noise and Vibration, (HD213/11 – Revision 1), 2011

Calculation of Road Traffic Noise (CRTN), 1988

Guidelines for Noise Impact Assessment, Institute of Environmental Management & Assessment, 2014

DEFRA noise map http://www.extrium.co.uk/noiseviewer.html, 2012

Environmental Noise Directive, 2002/49/EC, 2002

Environmental Noise (England) Regulations, 2006

WHO Night Noise Guidelines for Europe, 2009

Road Drainage and Water Environment

British Geological Survey (2017) British Geological Survey's Geology of Britain Viewer. Available at http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html, accessed February 2018

CIRIA (2002) Control of Water Pollution from Construction Sites – Guide to Good Practice (C532)

CIRIA (2006) Control of Water Pollution from Linear Construction Projects (C648)

CIRIA (2015a) Environmental Good Practice on Site (Fourth Edition) (C741) CIRIA (2015b) The SuDS Manual (Second Edition) (C753)

Department for Communities and Local Government (2019) National Planning Policy Framework (NPPF)

Department for Communities and Local Government (2014) Flood risk and coastal change. Available online at https://www.gov.uk/guidance/flood-risk-and-coastal-change, last accessed September 2017

Environment Agency (2014). Pollution Prevention Guidance, available online at https://www.gov.uk/government/collections/pollution-prevention-guidance-ppg. Last accessed February 2018

Environment Agency (2016) Anglian River Basin Management Plan, available online at https://www.gov.uk/government/collections/river-basin-management-plans-2015#anglian-river-basin-district-rbmp:-2015. Last Accessed February 2018

Environment Agency (2017a) Groundwater protection. Available online at https://www.gov.uk/government/collections/groundwater-protection, last accessed February 2018

Environment Agency (2017b) Flood map for planning. Available online at https://flood-map-for-planning.service.gov.uk, last accessed September 2017

Environment Agency (2017c) Long term flood risk assessment for locations in England. Available online at https://flood-warning-information.service.gov.uk/long-term-flood-risk/, last accessed September 2017

Environment Agency (2018a) Catchment Data Explorer. Available online at http://environment.data.gov.uk/catchment-planning/, last accessed January 2018

Environment Agency (2018b) What's in your backyard. Available online at http://apps.environment-agency.gov.uk/wiyby/default.aspx, last accessed September 2017

Environment Agency (2018c) Environmental Permits. Available online at https://www.gov.uk/topic/environmental-management/environmental-permits, last accessed February 2018.

Highways Agency (2008) Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2 'General Principles of Environmental Assessment'

Highways Agency (2009) DMRB Volume 11, Section 3, Part 10 'Road Drainage and the Water Environment' (HD 45/09)

Highways Agency (2016a) DMRB Volume 4 Section 2 Part 1 (HD 49/16) Highway Drainage Design Principal Requirements

Highways Agency (2016b) DMRB Volume 4 Section 2 Part 3 (HD 33/16) Design of Highway Drainage Systems

Norfolk County Council (2015) Norfolk Local Flood Risk Management Strategy, available online at https://www.norfolk.gov.uk/-/media/norfolk/downloads/what-we-do-and-how-we-work/policy-performance-and-partnerships/policies-and-strategies/flood-and-water-management/norfolk-local-flood-risk-management-strategy.pdf?la=en, last accessed February 2018

People and Communities - Social

Highways Agency (2009). Design Manual for Roads and Bridges Interim Advice Note 125/09 (IAN 125/09) Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment'.

Highways Agency (1993). Design Manual for Roads and Bridges Volume 11 Section 3 Part 9, Vehicle Travellers.

People and Communities – Travellers

Highways Agency (2009). Design Manual for Roads and Bridges Interim Advice Note 125/09 (IAN 125/09) Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment'

Highways Agency (2015). Design Manual for Roads and Bridges Interim Advice Note 125/15 (IAN 125/15) Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment Update'

Highways Agency (1993). Design Manual for Roads and Bridges Volume 11 Section 3 Part 8, Pedestrians, Cyclists, Equestrians and Community Effects

Highways Agency (1993). Design Manual for Roads and Bridges Volume 11 Section 3 Part 9, Vehicle Travellers

Climate

BSI (2016) PAS 2080:2016 Carbon Management and Infrastructure

Committee on Climate Change (2017) UK Climate Change Risk Assessment Synthesis Report

Department for Business, Energy & Industrial Strategy (2017a) UK Local Authority and Regional Carbon Dioxide Emissions National Statistics: 2005-2015 [online] available at: https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-2015, last accessed August 201

Department for Business, Energy & Industrial Strategy (2017b) Updated Energy and Emissions Projections 2016 [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/599539/Updated_energy_and_emissions_projections_2016.pdf, last accessed July 2017

Department for Transport (2014) National Policy Statement for National Networks

Department for Transport (2015) TAG Unit A3 Environmental Impact Appraisal [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/638648/TAG_unit_a3_envir_imp_app_dec_15.pdf, last accessed July 2017

Highways England (2016) Climate Adaptation Risk Assessment Progress update 2016

Highways England (2017) Major Projects' Instruction (MPI-57-052017) (Rev 1) 'Environmental Impact assessment: implementing the Requirements for 2011/92/EU as amended by 2014/52/EU (EIA Directive)'

IEMA (2015) IEMA Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation

IEMA (2017) IEMA Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance

Norfolk County Council (2016) Greenhouse Gas Report 2015/16 [online] available at: https://www.norfolk.gov.uk/-/media/norfolk/downloads/what-we-do-and-how-we-work/policy-performance-and-partnerships/performance/corporate/greenhouse-gas-report-2015-16.pdf, last accessed August 2017

Norwich City Council (2017) Carbon Footprint Report 2016-17 [online] available at: https://www.norwich.gov.uk/download/downloads/id/4058/carbon_footprint_report_2016-17.pdf, last accessed August 2017

The Met Office (2016) Eastern England: Climate [online] available at: http://www.metoffice.gov.uk/climate/uk/regional-climates/ee, last accessed August 2017

UKCP09 Climate Projections: East of England Maps & Key Findings [online] available at: http://ukclimateprojections.metoffice.gov.uk/23955?emission=high, last accessed August 2017