M2 Junction 5 Improvements Environmental Statement Volume 1 - Main Report

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1. Introduction

1.1 Overview of the project

1.1.1 In December 2014, the Department for Transport (DfT) published its Road Investment Strategy (RIS) for 2015-2020[1], announcing £15 billion to invest in England's strategic road network between 2015 and 2020. The RIS sets out the list of schemes that are to be delivered by Highways England over the period covered by the RIS (2015 - 2020). Highways England responded to the RIS with the Highways England Delivery Plan (2015) and a number of schemes have been identified to be constructed within the plan period, including the improvement to Junction 5 of the M2 in Kent (the 'Scheme').

1.1.2 The Scheme is located 58 km from the centre of London and 5 km northeast of Sittingbourne, as shown in Figure 1.1 in Volume 3. Improvements are required to address road safety, capacity and network performance issues.

1.1.3 The M2 is an important motorway linking Rochester to Faversham and a key route to the Port of Dover. Junction 5 of the M2 is the main access point for people travelling northeast to Sittingbourne, the Isle of Sheppey and the Port of Sheerness, and southwest to Maidstone and surrounding villages.

1.1.4 The M2 Junction 5 improvements are one of the major improvements identified in RIS. The junction improvements were originally proposed in Kent County Council's 2010 framework for regeneration, Growth without Gridlock; and in 2014 in Swale Borough Council's Draft Transportation Strategy and the South East Local Economic Partnership's Growth Deal and Economic Plan[2].

1.1.5 Construction of the Scheme is proposed to commence in 2020. The overseeing organisation and project sponsor is Highways England and the designer is Atkins. The Preferred Route Announcement for scheme option, Option 4H1, was made in May 2018.

1.1.6 The proposed improvements at M2 Junction 5 involve the replacement of the existing Stockbury roundabout with a new grade-separated junction[3] which is a flyover to provide free-flowing movement along the A249. Two new dedicated slip roads between the A249 and M2 will be provided and the existing connection from Maidstone link road to the roundabout will be closed and will be rerouted to Oad Street.

1.2 Overseeing organisation

1.2.1 The responsible organisation for the Scheme is Highways England, a government company charged with operating, maintaining and improving England's motorways and major A roads.

1.3 The designer

1.3.1 Atkins Ltd is appointed as the designer under Highways England's Project Support Framework to undertake the Preliminary Design of the Scheme. This

[1] Road Investment Strategy: 2015 to 2020, Department for Transport and the former Highways Agency, December 2014
[2] South East Local Enterprise Partnership, Growth Deal and Strategic Economic Plan, 2014
[3] Junction layout with two or more road roads at different heights to maintain traffic flows

includes responsibility for the Environmental Impact Assessment (EIA) and the preparation of the Environmental Statement.

1.4 Consenting regime

1.4.1 As set out in the Statement of Reasons to the Orders, the following Orders are required for the Scheme under the provision of the Highways Act 1980 (as amended) and the Acquisition of Land Act 1981:

a) The Highways England (A249 Trunk Stockbury Roundabout Improvements) Compulsory Purchase Order 2019 (the "CPO");

b) The Highways England (A249 Trunk Stockbury Roundabout Improvements) (Side Roads) Order 2019 (the "SRO"); and

c) The A249 Trunk Road (Stockbury Roundabout Improvements) Order 20[..] (the "Line Order").

Together, the "**Orders**".

1.5 Purpose of the Environmental Impact Assessment and Environmental Statement

1.5.1 Environmental Impact Assessment (EIA) is a process for identifying the likely environmental effects (positive and negative) of proposed developments, and their significance, before development consent is granted.

1.5.2 The aim of EIA is to ensure a thorough assessment of likely effects and that consideration of mitigation and alternatives in light of these potential effects has been undertaken. Through this process, the development should include measures to prevent, reduce or offset any significant, adverse environmental effects of the proposals, and enhance the positive ones.

1.5.3 The findings of the assessment are presented in this Environmental Statement (ES). The purpose of the ES is to help the decision maker, statutory consultees, the public and other stakeholders to properly understand the predicted effects and the scope for reducing them, before a decision is made as to whether to permit development.

1.5.4 The full ES comprises four volumes in total as follows:

- The Environmental Statement Main Text setting out the environmental assessment in chapters (Volume 1);
- The Environmental Statement Appendices (Volume 2);
- The Environmental Statement Figures, including drawings, photos and other illustrative material (Volume 3); and
- The Environmental Statement Non-Technical Summary (Volume 4).

1.5.5 The following topics have been assessed as part of this EIA:

- Air quality;
- Noise and vibration;
- Biodiversity;
- Road drainage and the water environment;
- Landscape and visual;
- Geology and soils;
- Cultural heritage;
- Materials and waste,
- Population and human health;
- Climate change; and
- Cumulative effects.

1.5.6 The EIA has been undertaken by a team of specialists working in collaboration with the design engineers responsible for the preliminary design of the Scheme as part of an iterative design, consultation and assessment process. This has maximised the opportunity to avoid or reduce environmental effects at source and to identify the most effective mitigation of those effects that cannot be avoided.

1.6 Need for Environmental Impact Assessment

1.6.1 Under Section 105B of the Highways Act 1980 (as amended) it has been determined that the M2 Junction 5 Scheme should be the subject of an EIA to identify the likely environmental effects and their significance.

1.6.2 An EIA has been undertaken and reported in this ES in accordance with the EIA (Miscellaneous Amendments Relating to Harbours, Highways and Transport) Regulations 2017[4] and pertaining to the amended provisions under the Highways Act 1980.

1.6.3 The EIA (Miscellaneous Amendments Relating to Harbours, Highways and Transport) Regulations 2017 are referred to in the ES as the “EIA Regulations”.

1.6.4 These Regulations apply the amended EU directive 2014/52/EU[5] “on the assessment of the effects of certain public and private projects on the environment” (usually referred to as the ‘Environmental Impact Assessment Directive’) to the planning system in England.

[4] Environmental Impact Assessment (Miscellaneous Amendments Relating to Harbours, Highways and Transport) Regulations 2017 S.I. 2017/1070
[5] Directive 2014/52/EU amending the directive 2011/92/EU on the assessment of effects of certain public and private projects on the environment. European Commission, 2014.

1.7 Legislative and policy framework

Policy overview

1.7.1 A summary of the key support and considerations for the Scheme identified in the relevant national, regional and local policy documents for the Scheme are set out below in Table 1.1.

Table 1.1: Policy overview

Scale	Legislation/ regulation	Summary of requirements
National	Road Investment Strategy (2014) [6]	Promote safe movement, satisfy users of the network, support efficient movement, improved environmental outcomes, support local access and well-being and be demonstrably cost effective.
	National Policy Statement on National Networks (NPSNN) (2014)[7]	The Government has produced a series of National Policy Statements (NPS), including the NPS on National Networks (DfT, 2013), which includes roads, published on the 7th May 2014. The National Networks NPS sets out "the Government's vision and policy for the future development of nationally significant infrastructure projects on the national road and rail networks" paragraph 1.4 states that "the NPS may also be a material consideration in decision making on applications that fall under the Town and Country Planning Act 1990 or any successor legislation". The NN NPS Identifies that there is a critical need to address road congestion and provide safe, expeditious and resilient networks that should be designed to minimise social and environmental impacts and improve quality of life.
	National Planning Policy Framework (NPPF) (2019)[8]	The NPPF sets out the Government's planning policies for England and requirements for the planning system. It provides a framework within which local authorities and residents can produce local and neighbourhood plans reflecting the needs and priorities of communities. The NPPF advises that local authorities should take account of the need for strategic infrastructure, including nationally significant infrastructure within their areas.
	Highways England Business Plan[9]	Support short-term targets as well as long-term aspirations and not significantly impact on network availability.
	Highways England: Licence 2015[10]	Includes both statutory and directions and guidance issued by the Secretary of State to Highways England who must minimise the environmental impacts of operating, maintaining and improving its network and seek to protect and enhance the quality of the surrounding

[6] Road Investment Strategy: 2015 to 2020, Department for Transport and the former Highways Agency, December 2014
[7] National Policy Statement for National Networks, Department for Transport, December 2014.
[8] Department for Communities and Local Government (2019). National Planning Policy Framework. London: DCLG
[9] Highways England: Strategic Business Plan 2015 to 2020. Department for Transport 2014
[10] Highways England: Licence, Department for Transport, 2015

Scale	Legislation/ regulation	Summary of requirements
		environment as well as conform to the principles of sustainable development.
Regional	Draft London Plan (2018)[11]	Recognises the importance of working collaboratively with a wide range of strategic partners to achieve good transport connectivity within London and also between London and the wider South East.
	Kent Council Local Transport Plan (2016-2031)[12]	The plan identifies that upgrades to M2 Junction 5 are required to provide free-flow between the M2 and A249 and alleviate capacity issues.
Local	Swale Borough Council Local Plan 2017[13]	The strategy emphasises the need to relieve problems of congestion and safety at Junction 5 of the M2 and A249 these issues are also addressed by the national roads programme. Junctions on the A249 corridor also need upgrading to support further long-term growth.
	Swale Local Transport Strategy Draft 2014-2031[14]	The transportation strategy for Swale is a comprehensive document identifying transport issues and potential solutions within the Borough. A key transport issue identified is the congestion at M2 Junction 5; this congestion acts as a barrier to further development in Swale.
	Medway Council Local Plan 2003[15]	The local plan identifies the need for traffic management including improving the road network's capacity using measures such as one way systems and linking traffic lights along a stretch of road. Medway Council is currently working on a new Local Plan, which will replace the 2003 Plan. This is likely to be issued in 2019.
	Medway Council Plan 2016/17-2020/21 2017/18 Update	The Council's business plan sets out how the Council will provide the best possible services for its residents. The plan identifies the need to tackle congestion hotspots.
	Maidstone Borough Council Local Plan 2017[16]	Policy SP 2 identifies key highway and infrastructure requirements including improvements to the M20 junction 5 roundabout.

Table Source: Various

1.8 Competent expert evidence

1.8.1 In accordance with the EIA Regulations 2017 and Highways England guidance, the coordination of the environmental assessment process and specialist assessments have been undertaken by a team of competent and qualified

[11] Draft New London Plan, Mayor of London 2018
[12] Local Transport Plan 4: Delivering Growth without Gridlock (2016-2031). Kent County Council
[13] Bearing Fruits 2031, Swale Borough Council, 26 July 2017.
[14] Swale Local Transport Strategy Draft 2014-2031. Kent County Council 2014
[15] Medway Local Plan. Adopted 2003.
[16] Maidstone Borough Local Plan, Maidstone Borough Council, October 2017

consultants, who are registered with the relevant institutions and/or Chartered. Atkins is EIA Quality Mark registered through the Institute of Environmental Management and Assessment (IEMA). Accreditation is based around compliance with a series of EIA commitments, which IEMA regularly independently monitors through an annual review process. The EIA Quality Mark therefore provides registrants with a benchmark for their EIA activities and demonstrates a commitment to effective practice. Continued registration requires all of Atkins EIA coordinators and practitioners to be aware of the commitments and deliver EIA to a high standard. It also requires volunteers to write short articles, present at IEMA events or webinars, and produce case studies as part of the commitment to improve EIA practice and share knowledge across the industry.

1.8.2 Evidence for each specialist is found at the beginning of each environmental topic chapter (Chapters 5-15).

1.9 Consultation overview

Previous consultation

1.9.1 Initial engagement with key stakeholders and statutory bodies was undertaken in early 2017. The non-statutory informal consultation took place between 6th September to 17th October 2017 where the public were asked to respond to the previous proposed Option 12A. A summary of the consultation is provided in the M2 Junction 5 Report on Public Consultation (May 2018)[17], which provides more details and is available on the Highways England website: https://highwaysengland.citizenspace.com/he/m2-junction-5-improvements/results/m2j5-reportonpublicconsultation.pdf.

Communication plan

1.9.2 As part of the Option Identification Stage of the Scheme a draft Communication Plan (2016) was developed which sets out the approach to engagement and communication with stakeholders. It describes the communication objectives, the key messages stakeholders need to know about the Scheme and the channels in which to convey messages to stakeholders. As part of the plan, the Communications Planner tracks activities which have taken place with statutory and non-statutory stakeholders during the Preliminary Design Stage.

Preliminary design stage consultation

1.9.3 A number of non-statutory consultation meetings have occurred during the Preliminary Design Stage to discuss issues with stakeholders and to obtain and provide information on the Scheme. The project team has also met with the Local Planning Authorities (Kent County Council, Swale, Maidstone, and Medway Borough Councils) on a regular basis.

[17] Highway England, M2 Junction 5 Report on Public Consultation May 2018

2. The project

2.1 Need for the project

2.1.1 The M2 Junction 5 has capacity constraints resulting in unsatisfactory network performance. This affects M2 east-west movements and A249 north-south movements between Sittingbourne and Maidstone, with current traffic demands significantly exceeding capacity. In particular, the approach to the junction from the east experiences high levels of delay.

2.1.2 The Scheme is required to provide for planned residential and commercial development. Swale Borough Council is planning for an additional 14,124 dwellings and 130,000 m^2 of employment land up to 2031 (Swale Borough Council, 2017[18]). This scale of development is expected to have a significant impact on the performance of the M2 Junction 5. Growth plans set out in the Local Economic Partnerships' Strategic Economic Plan[19] are likely to be inhibited by a lack of capacity at this junction. In addition, the Kent Corridors to M25 Route Strategy Evidence Report (Highways Agency, 2014) identified that more efficient operation of the M2 Junction 5 would be essential to secure the economic development potential of the area.

2.1.3 The Scheme is also required due to safety concerns, as identified during the route based strategy sifting process. The M2 Junction 5 is one of the top 50 national casualty locations on England's major 'A' roads and motorways, and one of the main areas within the Kent Corridors to M25 Route Strategy Evidence Report[20] which interacts with vulnerable road users. There were 111 personal injury accidents recorded between January 2011 and December 2015, with almost half of these occurring during the morning and evening peak periods.

2.1.4 Additionally, people travelling to and from the Maidstone area currently use rural roads to avoid the congested M2 Junction 5. This puts pressure on the local road network, which is not suited to large volumes of traffic and results in increased safety risks.

2.1.5 The commitment to undertake a detailed improvement study at the M2 Junction 5 was initially made as part of the 2014 Autumn Statement.[21] This commitment was subsequently confirmed in the DfT RIS. The improvements will contribute to national transport objectives by:

- Providing additional capacity;
- Enhancing journey time reliability;
- Improving the safety of the M2 Junction 5 and surrounding local road network for road users; and
- Supporting the development of housing and the creation of jobs.

[18] Bearing Fruits 2031: The Swale Borough Local Plan 2017
[19] Local Economic Partnerships' Strategic Economic Plan (South East Local Enterprise Partnership, 2014)
[20] Kent Corridors to M25 Route Strategy Evidence Report, former Highways Agency, April 2014
[21] Autumn Statement 2014, HM Treasury, the Rt Hon Danny Alexander and the Rt Hon George Osbourne, 8 December

2.2 Project objectives

2.2.1 In line with the NPSNN and the overarching objectives of the DfT RIS, the objectives of the Scheme are to:

- **Support economic growth** – To enhance the capacity, connectivity and resilience provided by the M2 J5, in order to contribute positively to strengthening the local and regional economic base, delivering housing allocations within the Swale Local Plan and promoting economic growth across the region;
- **A safe network** – To improve safety and security offered by M2 J5 to all road users. By reducing the number of KSI (Killed and Seriously Injured) and slight collisions;
- **A more free flowing network** – To improve the journey quality and journey time and reliability for all routes through M2 J5; and
- **An improved environment** – To deliver a high standard of design for any M2 J5 improvement that reflects the quality of the landscape and setting, and that minimises the adverse environmental impact of new construction.

2.3 Project location

2.3.1 The Scheme location and boundary are shown on Figure 1.1 in Volume 3. The Scheme is located 58 km from the centre of London, 5 km northeast of Sittingbourne. The M2 is an important motorway linking Rochester to Faversham and a key route to the Port of Dover. Junction 5 of the M2 is the main access point for people travelling northeast to Sittingbourne, the Isle of Sheppey and the Port of Sheerness, and southwest to Maidstone and surrounding villages.

2.4 Environmental context and constraints

2.4.1 Junction 5 of the M2 sits within a valley and the land surrounding the junction is predominately rural. To the north of the junction, the landform is that of a rolling arable landscape, with medium sized agricultural fields. The rural lanes are densely vegetated by hedgerows and hedgerow trees. Large fields dominate the area to the north of the M2. Small areas of Ancient Woodland, Church Wood and Chestnut Wood, are adjacent to the junction.

2.4.2 To the south of the M2, the landform is gently undulating, typical of a dry valley landscape, with a series of dip slope valleys. The landform of the dip slope limits views to areas within the valley and resultantly towards the existing A249 which is situated within the base of the valley. Land use around the junction is a mixture of agriculture, cropping, orchards and equestrian fields.

2.4.3 Settlement in the area consists of groups of properties located along Maidstone Road, north of the roundabout and along Sittingbourne Road/A249, south of the roundabout. Farmsteads are also scattered along Oad Street, Pett Road and South Green Lane.

2.4.4 The A249 dual carriageway and M2 motorway are prominent infrastructure features. Both are in direct contrast to the historic and traditional pattern of rural roads within the area, which are often narrow, winding and have sharp bends.

2.4.5 The junction sits within the Kent Downs Area of Outstanding Natural Beauty (AONB), the M2 corridor forms the northern boundary for the AONB. The Kent Downs AONB is renowned for its special characteristics, including: its dramatic landform and topography, panoramic and long-ranging views, rich habitats, mixed farmland, extensive Ancient Woodland, tranquillity, remoteness and its historic and built heritage.

2.4.6 The key environmental issues and constraints which have been taken into consideration in the assessment and design process are as follows:

- The Scheme is within the Kent Downs Area of Outstanding Natural Beauty (AONB) designated for conservation due to its significant landscape value. This covers the eastern half of the North Downs and stretches from the London/Surrey borders to the White Cliffs of Dover;
- There is ancient semi-natural woodland (Church Wood and Chestnut Wood) located immediately adjacent to the existing junction;
- There is potential for a range of protected species to occur within or close to the Scheme boundary including invertebrates (terrestrial and aquatic), bats, hazel dormouse, badgers and reptiles;
- There are no European designated nature conservation sites within 2 km of the Scheme. However**,** North Downs Woodlands Special Area of Conservation (SAC), and Peters Pit SAC are within 200 m of the Affected Road Network (ARN);
- There are heritage assets (a Scheduled Monument, Grade I, II* and II Listed Buildings, WWII air crash sites, one non-designated historical landscape, non-designated heritage assets and a find spot) nearby;
- A WWI pill box, associated with the Chatham Land Front WWI defences, was identified during site walkovers. This is located adjacent to the southern footprint of the junction. During the geophysical surveys, several anomalies were also detected that have been interpreted as potential former trenches that form part of the Chatham Land Front WWI defences;
- The Scheme is located at the boundary of Maidstone Borough Council and Swale Borough Council which have one and four designated Air Quality Management Areas (AQMAs) respectively, for exceedance of the annual mean nitrogen dioxide objective. The Scheme is also located close to six Noise Important Areas (NIAs);
- The Scheme is located in Flood Zone 1 which is described as land assessed as having a less than 0.1% (1 in 1000) annual probability of fluvial (river) flooding in any year and is only at risk of flooding from localised surface water run-off. The junction is partially located within the Total Catchment (Zone 3) and Outer Zone (Zone 2) of a designated Groundwater Source Protection Zone. There is a ditch that flows parallel to the A249 and a pond located to the south of the junction;
- The wider study area for the Scheme is underlain by the Seaford Chalk Formation while the Thanet Formation (sand, silt, and clay) outcrops in the northern, north eastern and eastern parts of the study area. The Seaford

Chalk Formation is a Principal Aquifer, while the superficial Head Deposits underlying the study area are a Secondary (Undifferentiated) Aquifer; and

- There are several Public Rights of Way which are adjacent to or intersect with sections of road within 500 m of the junction.

2.4.7 The environmental constraints associated with the Scheme are shown in Figure 2.1 in Volume 3.

2.5 Project description

Scheme overview

2.5.1 Figure 2.2 Scheme drawings (6 Sheets) are included in Volume 3. The Scheme has been developed over previous project stages based on analysis and assessment of traffic, engineering, buildability and environmental factors, as well as consultation with stakeholders and the local community.

M2 Junction 5 improvements

2.5.2 The proposed Junction 5 improvements involve the replacement of the existing Stockbury roundabout with a new grade-separated junction.

2.5.3 Stockbury roundabout will remain at-grade and would be enlarged to accommodate connections to the roundabout. The A249 mainline will flyover the Stockbury roundabout, with the approaches on embankments and retaining walls, and with two single span bridges over the roundabout.

2.5.4 Four new slip roads will be provided, three of which include dedicated left turn lanes at the roundabout for the following turning movements:

- A249 southbound to M2 westbound;
- A249 northbound to M2 eastbound; and
- M2 eastbound to A249 northbound.

2.5.5 The existing Maidstone Road connection with Stockbury roundabout will be stopped up and a new Maidstone Road link will be provided, connecting to Oad Street to the north of the M2.

2.5.6 A new link road will be provided between Stockbury roundabout and Oad Street, with the new link road connecting into Oad Street near the existing junction of Oad Street and the A249. The existing Oad Street and A249 junction would be closed. Oad Street will remain open for local access to properties but will not have direct access onto the A249 as currently exists. The existing southbound lanes of the A249 will be retained south of the existing junction with Oad Street and this will be converted into a two-way single carriageway to provide continued access to properties and land fronting this section of road and connection to South Green Lane.

2.5.7 The Honeycrock Hill junction with the A249 will be stopped up.

Lighting

2.5.8 During operation, it is assumed that the roundabout, and its approaches, will remain lit.

2.5.9 The proposed lighting design consists of 68 columns that range in height from 5 m to 12 m from the carriageway level with the majority of columns having single arms and 2 columns with twin brackets. There are 70 luminaires as two of the 10 m columns have twin brackets. All luminaires will be Light Emitting Diode (LED) light sources and no light emission will be above the horizontal.

2.5.10 The proposed lighting extents are, in accordance with standards, 156 m on each approach to the roundabout. Two of the roads are only for exit, i.e. no approach (leading to the A249 on-slips), and will only need to be lit to a distance of 60 m.

2.5.11 The new road lighting design has taken into consideration careful design measures, including the use of LEDs, to avoid and/or minimise light spill onto adjacent areas, particularly within the Kent Downs AONB.

Non-motorised user provisions

2.5.12 There are several Public Rights of Way (PRoWs) which are adjacent to or intersect with the sections of road and will be considered within the assessment. These PRoWs include a network of footpaths and a bridleway. The PRoWs allow non-motorised users (NMUs) travelling between the villages of Danaway, Stockbury and Lower Harlip to cross the existing M2 Junction 5. Affected PRoWs are as follows:

- ZR71 – a footpath connecting Wormdale Hill Road outside Danaway and Bull Lane in Hartlip, parallel to the north of the M2, and to the west of the A249;
- An unnamed footpath and bridleway along Green Lane in Stockbury, which connects to a footbridge that extends across the M2;
- A footbridge connecting the above footpaths across the M2; and
- KH85 – a footpath connecting Church Wood and the above footbridge with the A249. The footpath is considered as a dead end as it does not include a safe crossing point on the A249.

2.5.13 None of the roads which are considered in this assessment are suitable for use by pedestrians, cyclists or equestrian users. No pavements or dedicated cycleways are present which would encourage this use.

2.5.14 The Scheme design proposes to extend the public footpath to link the end of the existing KH85 footpath along to the bottom of the Honeycrock Hill/A249 Junction which is being stopped up. An opportunity exists to provide a higher-level right-of-way (i.e. a bridleway or a byway) instead of a footpath to provide access for all NMUs which will be considered in the next stages of the design. The footpath (ZR71) will also be relocated further to the north as shown on the Scheme drawings Figure 2.2 in Volume 3.

2.5.15 There are six bus stops within the Scheme area. Two of these are located on either side of the A249, approximately 60 m south of where Oad Street meets

the A249. Two others are located just north of where Church Hill meets the A249 and a further two are located on either side of Maidstone Road approximately 800 m north of Junction 5. The Scheme proposes to maintain the existing bus route through the centre of the roundabout.

2.5.16 The two bus stops near the junction (located either side of the A249) will be relocated to the Oad Street link. The bus stops currently located north of Church Hill have recently been closed by the bus company due to safety reasons and these will not be re-opened as part of the Scheme.

Preliminary environmental design

2.5.17 The Preliminary Environmental Design shown on Figure 2.3 (5 Sheets) in Volume 3 shows mitigation which has been embedded with the Scheme design, including areas of new landscape planting, habitat creation and new NMU routes. These mitigation measures have been developed through an iterative design process with a multidisciplinary team responding to a complex range of environmental and engineering constraints found within and adjacent to Junction 5 and embedding the design principles identified in the Road to Good Design 2018[22].

2.5.18 The Scheme has been designed as far as possible to avoid key environmental features. This process will continue during the Scheme's detailed design development to ensure that any additional design opportunities are identified to avoid residual environmental impacts on key environmental features that are currently the result of the preliminary design.

2.5.19 The proposed mitigation has focused on the following principles, which have also formed part of the iterative design process for the Scheme:

- Retaining and protecting existing mature trees and hedges wherever possible, maintaining important visual screening and biodiversity habitat;
- No overall loss of ecologically valuable habitat; and
- Retaining natural character and planting local native species of local provenance.

2.5.20 The proposed preliminary environmental design includes the following specific mitigation measures:

- Extensive new woodland along Church Hill, adjacent to Church Wood, along the west side of the A249 and some areas along the eastern side of the A249 will replace the loss of the existing screening vegetation and provide connectivity;
- The new Oad Street and Maidstone Road link roads will be planted to provide screening, connectivity and new habitats;
- Translocation of a hedgerow along Oad Street and Honeycrock Hill;
- Species rich grassland provided where the design allows;
- Natural flint stone cladding along the flyover retaining walls to reflect the

[22] Highways England, the Road to Good Design, 2018

local vernacular and character of the area; and

- A new aquatic pond provided to replace the loss of existing aquatic habitat.

2.5.21 In addition, the Scheme drainage strategy has been reviewed to manage the existing water environment and highway drainage to ensure that during operation there is no deterioration and where possible the Scheme includes features such as new infiltration basins and soakaways and unlined ditches to achieve a betterment. During operation design measures are required:

- To treat contaminants in normal road run-off;
- To deal with any accidental spillages occurring on the carriageway;
- To prevent any increase to flood risk in the area; and
- To protect and enhance wildlife corridors near drains.

2.5.22 The design of the drainage system would comply with all current standards and Sustainable Drainage Systems (SuDS) best practice techniques to ensure that sustainability is a key drainage design criterion.

2.5.23 Habitat creation has been identified as part of the preliminary environmental design to mitigate and compensate for the loss of key environmental features such as reptile and dormouse as well as other habitats. Habitat creation will result in the establishment of approx. 6.09 ha woodland, 10.23 ha species-rich grassland, 2.63 ha scrub, 3,778 m native hedgerow, and an extra 50 m^2 of ponds, which will contribute to an overall increase in the total area of terrestrial habitats. These measures outlined above will incorporate the provision of additional ecological enhancements, including marginal and emergent planting to attenuation ponds, dead wood piles (i.e. hibernacula) and new connecting planting (i.e. scrub and hedgerows) to provide improved habitat connectivity for the movement of hazel dormice and bats adjacent to the Scheme.

Order Limits

2.5.24 The draft Order Limits (also known as the ‘Scheme boundary’) are shown on the Scheme drawings in Figure 2.2 (6 Sheets) in Volume 3. The Scheme boundary includes all the permanent land take (i.e. the areas outside the existing highway boundary but within the proposed highway boundary) for all works proposed. The total permanent land take required for the Scheme totals 16.3 ha.

2.6 Construction, operation and long-term management

2.6.1 Construction of the Scheme is currently programmed to commence in spring 2020 and is expected to take approximately 18 months. This programme is based on the assumption that there will be no public inquiry for the Scheme and additional land required outside the existing highways boundary will be acquired by agreement, (i.e. no Compulsory Purchase Order required) before September 2019.

2.6.2 Specific construction, operational and long-term management arrangements are not available in detail or confirmed at this stage of the Scheme. Balfour Beatty have been involved as an Early Contractor Involvement (ECI) Contractor advising on buildability as part of the Preliminary Design Stage. This includes an

outline 18 month construction programme and advice on construction that topic chapters have taken into account as part of their assessments. The assessments of construction effects also assume best practice, based on industry guidance and professional experience. This programme is available in the Outline Environmental Management Plan (OEMP) (refer to Appendix A in Volume 2), which also includes a record of environmental actions and commitments (REAC).

2.6.3 The outline 18 month construction programme assumes a start in spring 2020. Pre-construction works including site mobilisation (establishment of construction compounds), site clearance and any required ecological mitigation works will be completed between September 2019 and spring 2020, prior to the start of construction.

2.6.4 A schedule of ecological mitigation works is included in Chapter 7 Biodiversity and Table 7.9, many of these mitigation works will commence from September 2019 to ensure habitat protection and creation prior to start of construction.

2.6.5 The work at Junction 5 will be undertaken in two stages, the first phase of works will be for works on Maidstone Road and Oad Street and the second phase will be the remainder of the works.

2.6.6 Working hours throughout the programme on average will be 07.00 – 17.00, extended to 19.30 in the summer.

2.6.7 All phases will require overnight working for:

- Changes to traffic management layouts; and
- Surfacing to slip roads and junctions where traffic management is required to close or restrict multiple lanes to one lane.

2.6.8 The proposed locations of construction compounds for the contractor have been identified and are included within the land take for the Scheme. These are shown on Figure 2.2 Scheme drawings in Volume 3.

2.6.9 Balfour Beatty, the ECI contractor, have also provided the following advice on construction that topic chapters have taken into account as part of the assessments:

- Material will be generated as the result of new and modified highway earthworks and the excavation of drainage features. The initial estimate for the total volume of earthwork materials generated and required for the construction is approximately 143,000 m^3 (assumed to be aggregate) and total waste from the Scheme is approximately 212,000 m^3;
- Deliveries will be routed via the M2/M20/A249. Local roads will not be used as delivery routes. The majority of construction traffic will come from the north along the M2 or from local quarries which are located around the M20;
- The number of heavy goods vehicles (HGVs) and other traffic travelling to site for the construction period will depend on the material quantities to be provided but as a rough guide we would expect around 20-50 HGV deliveries each day. During the project it is expected that approximately 6

HGV will be working around the junction each day, moving material, plant etc;

- It is not anticipated that haul roads will be required to move material from one area on-site to another. The majority of excavated material will be topsoil and sub soil to allow imported fill to be placed to extend/widen existing embankments. Any top soil required to be re-used will be stored locally or be transported by road to the compound for storage and re-use.
- At peak times 150 workers would be expected to be on-site. It is anticipated that 60% of workers will be local (within 40 km of the Scheme) and 40% will be drawn from specialist subcontractors who operate nationally and use staff who may live further afield;
- Traffic management will be required for the full 18 months. It is assumed that during construction the M2 will have a speed restriction of 50 mph for the duration. This will be required because both slips roads will have lane restrictions and there may be a reduction in the capacity of the roundabout. During peak hours two lanes will be maintained along the A249 in both directions, it is assumed that these will be narrow lanes with a 15% drop in capacity. During off peak weekday times there will be lane closures and during off peak weekends there will be full closures to allow tie in works. It is assumed that for the slip roads, single lanes approaching and leaving the roundabout during the construction period will be required, depending on traffic flows and during peak times, two lanes may be made available;
- Speed limits for roads will be 50 mph and there will be a reduction to 30 mph at the roundabout;
- When the A249 is required to be closed, the A2 and the M20 will be used for diversion routes, no closures on the M2 are anticipated;
- During construction, existing NMU routes will be maintained where possible;
- The total water consumption over 18 months would be approximately 7,500 m^3. Of this the office requirement for portable water would be 400 m^3 (office consumption is based on 2 m^3 per person per year based on the water benchmark from Waste Resources Action Programme (WRAP) green office guide). On-site the water requirement would be for the road sweeper, reducing dust during the summer period, concrete wash down, flushing and cleaning drainage. There may be potential in the drainage design to re-use or collect water e.g. run off water could be re-used from attenuation ponds but as the majority of the area is on chalk, this is unlikely;
- In terms of total construction energy consumption, a total of 68,500 KWh for the length of the project is anticipated for construction lighting, signage etc in kilowatt hours (kWh) and the yearly office consumption would be approx. 45,700 KWh. Very little electric power will be used on-site as most of the energy will be produced by diesel engine. On-site lighting will be LED which is now more commonly powered by solar energy. These actual rates

compare with the rates from CIBSE TM46:2008, Category 1, General Office, Energy Benchmarks[23]; and

- On contract completion there is an expectation of the contractor to handover the Scheme with limited maintenance requirements for up to 10 years.

2.6.10 Although short-term anticipated maintenance requirements could include:

- Landscape maintenance to implement scheduled operations to maintain the existing soft estate retained within the Scheme boundary and proposed planting and ecological mitigation measures to assist with successful establishment;
- Regular monthly inspections of drainage features (checking for debris) including outfalls and inlets, and routine works e.g. vegetation cutting and removal of plant litter during the first year reducing to once a year, 1-5 years or 5-10 years depending on the design; and
- Cleaning and electrical testing of lighting after six years.

2.6.11 Maintenance of junctions will remain largely with the current highways authorities (i.e. Kent County Council east of the M2 and Highways England to the west).

Decommissioning

2.6.12 In view of the up to 120 year design life for structures, it is not considered appropriate for decommissioning to form part of the environmental assessment. The focus of the Scheme will be upon seeking to minimise disruption and re-use of materials which forms part of the materials assessment in Chapter 12. Decommissioning of the Scheme has therefore not been included in the ES.

[23] CIBSE TM46:2008, Category 1, General Office, Energy Benchmarks http://www.valeofglamorgan.gov.uk/Documents/Our%20Council/Achieving%20our%20vision/Partnerships,%20Policies%20&%20Plans/Local%20Service%20Board/Carbon%20Management/Arup%20and%20Carbon%20Trust%20Report%20-%20%20Appendix%20C%20CIBSE%20Benchmarks.PDF

3. Assessment of alternatives

3.1 Introduction

3.1.1 A staged approach was undertaken when developing options for the Scheme. In 2009, a number of potential short-term solutions to deliver improvements to M2 Junction 5 were developed.

3.1.2 Extensive optioneering was then undertaken which resulted in a range of options to improve the junction. After a review of the options, a number were discounted and the remaining options were taken forward and considered in the Option Identification and Option Selection Stages. These options were assessed in terms of their technical feasibility, safety, engineering, value for money and environmental considerations before identifying a single combined preferred option as part of the Option Selection Stage. The Preferred Route of M2 Junction 5 was announced in May 2018.

3.1.3 This chapter provides a chronology of the options considered to provide additional capacity on M2 Junction 5.

3.2 Reasonable alternatives studied

Strategy, shaping and prioritisation pre-project stage

3.2.1 In 2009, Jacobs identified short-term solutions (up until 2016) for Junction 5 to mitigate capacity issues in the short-term in line with planned development.

3.2.2 In 2016, further development and assessment of the options was undertaken and twelve options were developed which are listed in Table 3.1 below. Of the 12 options, 9 were discounted because they were considered unlikely to deliver significant positive effects in terms of relieving congestion, reducing queuing and improving local connectivity. The discounted options are described fully in the Stage 0 – Option Assessment Report. The three remaining options were progressed to Option Identification Stage for further consideration. These options are known as Option 4, 10 and Option 12.

Table 3.1: Scheme options identified during optioneering

Option	Brief description	Discounted or proposed	Reason
1	Widen A249 approach to 3 lanes from M2 viaduct	Discounted	Option unlikely to have a significant effect on congestion and queuing traffic. Benefit seen on A249 southbound only.
2	Widen A249 to 3 lanes from A2	Discounted	Option unlikely to have a significant effect on congestion and queuing traffic. Benefit seen on A249 southbound only.
3	Widen A249 to 3 lanes from A2, Maidstone Road joined to A249	Discounted	Option unlikely to have a significant effect on congestion and queuing traffic. Benefit seen on A249 southbound only.

Option	Brief description	Discounted or proposed	Reason
4	A249 fly-over/fly-under	Proposed	Option developed further for traffic, economic and environmental assessment.
5	Widen A249 Approach to 3 Lanes from M2 viaduct, free-flow link to M2 westbound	Discounted	Option unlikely to have a significant effect on congestion and queuing traffic. Benefit seen on A249 southbound only.
6	Through-route roundabout (conversion of existing junction)	Discounted	Option unlikely to show significant benefit without improvements. This became a new variant and was later developed into Option 12A.
7	2-tier dumbbell junction (at existing junction location)	Discounted	Less preferable to Option 4 due to space required for dumbbell roundabout. This also had local connectivity issues.
8	2-tier dumbbell junction (orientated north-south)	Discounted	Option unlikely to show significant benefit, with Scheme cost and complexity identified as other problems.
9	2-tier intersection (at M2 viaduct)	Discounted	Option unlikely to show significant benefit as A249 through movement still uses the roundabout.
10	3-tier intersection (at M2 viaduct)	Proposed	Option developed further for traffic, economic and environmental assessment.
11	4-tier intersection (at M2 viaduct)	Discounted	Whilst showing potential for benefits, option removed due to lack of local connectivity.
12	Enlarged roundabout with free-flow links (in existing location) Enlarged roundabout with free-flow links (in existing location)	Proposed	Option developed further for traffic, economic and environmental assessment.

Option identification

3.2.3 In addition to Options 4, 10 and 12, two additional options were considered at Option Identification Stage. These additional options were variations of Option 12 and are known as Option 12A and Option 12A Oad Street Alignment Route B.

3.2.4 Option 12A was developed as an enhanced version of Option 12 as it was considered likely that Option 12 would not deliver the capacity improvements required to provide for planned future growth in the area. Option 12A includes a new link road between the roundabout and Oad Street. The horizontal alignment of this link road would extend directly through Chestnut Wood, an Ancient Woodland which, under Paragraph 175 of The National Planning Policy Framework (NPPF)[24], planning permission should be refused for development

[24] Department for Communities and Local Government (2019). National Planning Policy Framework. London: DCLG.

resulting in the loss or deterioration of irreplaceable Ancient Woodland unless the benefits of the development in that location clearly outweigh the loss.

3.2.5 Option 12A was further refined to avoid Chestnut Wood in response to the NPPF which resulted in a further two alternative alignments for the new link road being considered. These included:

- Option 12A Oad Street Alignment Route B – this alternative alignment re-routes the new link road to the south of the buildings at Whipstakes Farm and avoids the need to remove Ancient Woodland. However, this option requires significantly more land take than Option 12A; and
- A further option which re-routes the new link road directly through the buildings at Whipstakes Farm, avoids impacts on Ancient Woodland and would simplify the Scheme from a design and engineering perspective as it would require a shorter length of new road than the first alternative and it removes the need for a bridge over Oad Street. However, this alternative alignment for the new link road was ultimately discounted in the following Stage due to the direct impacts it would have on residential property and farm buildings at Whipstakes Farm and the associated land take that would be required.

Option selection

3.2.6 Five options were progressed to Option Selection Stage in 2017. These included Options 4, 10, 12, 12A and 12A Oad Street Alignment Route B. These options were assessed in terms of technical feasibility, safety, engineering, value for money and environmental considerations.

3.2.7 Four of these options were subsequently discarded from further consideration based on cost and capacity performance:

- Option 4 and 10 were not progressed to public consultation as they were estimated as having associated costs of up to £158 million and £184 million respectively and could, therefore, not be delivered within the allocated budget of £50-£100 million;
- Option 12 was not progressed to public consultation as it would not create sufficient capacity for future planned growth in the area; and
- Option 12A was not progressed to public consultation as it would require the removal of Ancient Woodland and, given that there are alternatives to achieving the intended benefits of the Scheme, it would, therefore, not satisfy the national policy requirements.

3.2.8 Option 12A Oad Street Alignment Route B was selected as the preferred option to take to public consultation in September and October 2017. This option was the only option of the five which was thought to achieve the project objectives set out in Section 2.2 and avoided the need to remove Ancient Woodland while also falling within the £50-£100 million budget allocated to the Scheme under the DfT RIS.

Response to public consultation

3.2.9 Responses to consultation indicated some concern regarding the intrusive nature of the Oad Street link road alignment of Option 12A Oad Street Alignment Route B, including from the Kent Downs Area of Natural Beauty (AONB) Unit. As a result, a further variant of Option 12A was developed, referred to as Revised Option 12A.

3.2.10 Revised Option 12A involved the re-routing of the Oad Street link road to extend from the roundabout, along the southern edge of the A249 and connect into Oad Street near the existing junction of Oad Street with the A249, which was considered by most stakeholders to represent an improvement compared to Option 12A.

3.2.11 Further feedback received during public consultation indicated a strong public opinion in favour of reconsideration of Option 4. In response to this feedback, a variant of Option 4 was developed. The variant is referred to as Option 4H1 (described in Section 2) and includes the two-tier grade separated junction proposed under Option 4 but removes the dedicated free-flow slip road from the M2 eastbound to the A249 northbound, in order to bring the estimated cost of the option nearer to the £50-£100 million budget allocated to the Scheme under the DfT RIS. For the same reasons outlined with regard to Revised Option 12A above, Option 4H1 also includes the revised alignments for the Oad Street link road and Maidstone Road connection.

Preliminary Design Stage

3.2.12 In May 2018 the Preferred Route Announcement of Option 4H1 was published. Due to further consultation undertaken with the Kent Downs AONB, landowners and other consultees during the Preliminary Design Stage, further developments to Option 4H1 have occurred which are described in Chapter 2.

3.3 Justification for chosen option

3.3.1 Five options were identified and progressed into the Option Selection Stage.

3.3.2 Options 12, 10 and 4 were discounted from further design based on cost and capacity performance.

3.3.3 Option 12A was discounted from further design as it would necessitate direct loss of Ancient Woodland and would, therefore, not satisfy the policy tests of the NPSNN and NPPF given that there are alternatives to achieving the intended benefits of the Scheme.

3.3.4 Option 12A Oad Street Alignment Route B was discounted in response to feedback received during public consultation, which indicated a strong public opinion in favour of a grade-separated option and reconsideration of Option 4 and which raised concerns regarding the intrusive and overbearing nature of the Oad Street link road alignment.

3.3.5 Option 4H1 became the preferred junction option that has now been taken forward as the basis of the EIA and reported in this ES.

4. Environmental assessment methodology

4.1 Environmental Impact Assessment process

4.1.1 Environmental Impact Assessment (EIA) is a process for identifying the likely environmental effects (positive and negative) of proposed developments, and their significance, before development consent is granted.

4.1.2 The aim of EIA is to ensure that the following are undertaken:

- A thorough assessment of likely effects of a proposed development on the environment;
- Consideration of mitigation measures and alternatives in light of potential environmental effects; and
- Assessment of the cumulative effects of proposed development.

4.1.3 Through this process, the development should include measures to prevent, reduce or offset any significant, adverse environmental effects of the proposals, and enhance the positive impacts. The findings of the assessment are presented in an Environmental Statement (ES).

4.1.4 The purpose of the ES is to help the decision maker, statutory consultees, other stakeholders and the public properly understand the predicted effects and the scope for reducing them, before a decision is made as to whether to permit the development. For the Scheme, the planning application for Highways England will be supported by an ES produced in accordance with the EIA Regulations.

4.2 Structure of this Environmental Statement

4.2.1 The EIA regulations[4] set out the information that is required for an Environmental Statement. These requirements are reflected in the Design Manual for Roads and Bridges (DMRB) Volume 11[25] (and associated documents) which sets out the structure for Environmental Statements and the topics to be covered for a highways project. The earlier chapters of this ES included an introduction, information on the Scheme and details of alternatives considered. The environmental chapters in the ES cover the topics that are required to be assessed under the EIA regulations and include: air quality, noise and vibration, biodiversity, road drainage and the water environment, landscape and visual, geology and soils, cultural heritage, materials and waste, population and human health, climate change and cumulative effects.

Structure of each environmental topic chapters

4.2.2 Each environmental topic chapter is structured as follows:

- Introduction;
- Competent expert evidence;
- Legislative and policy framework;

[25] Design Manual for Roads and Bridges Volume 11 Sections 1-4. Highways Agency

- Study area;
- Assessment methodology;
- Assumptions and limitations;
- Baseline conditions;
- Potential impacts;
- Design, mitigation and enhancement measures;
- Assessment of effects;
- Cumulative effects;
- Monitoring; and
- Summary.

4.3 Competent expert evidence

4.3.1 To meet the requirements of the EIA 2017 Regulations this section provides evidence on the competence of the individuals responsible for undertaking the assessment, including their experience in their field, qualifications and membership of professional institutes.

4.4 Legislative and policy framework

4.4.1 This section sets out the key pieces of legislation and policy that are relevant to the topic and which the Scheme may be subject to or the assessment guided by.

4.5 Study area

4.5.1 Study areas are defined individually for each environmental topic, according to the geographic scope of the potential impacts relevant to that topic or of the information required to assess those impacts. It draws on guidance in DMRB Volume 11 and associated documents where this specifies the extent of study areas and other guidance where appropriate. The study areas are defined within each relevant topic chapter of this report.

4.6 Assessment methodology

4.6.1 The assessment methodology describes the guidance used for the assessment of each environmental topic, together with the criteria to determine the magnitude of effects and the sensitivity of receptors. For this Scheme, the assessment methodology has generally been adopted from DMRB Volume 11, Section 3. Where there is no standard guidance, this is stated, together with the methodology used to undertake the assessment.

4.7 Assumptions and limitations

4.7.1 Assumptions and limitations that have been identified in undertaking the EIA are listed. These can include limits on available design information at the time of writing the ES and assumptions on the type and methods of construction.

4.8 Baseline conditions

4.8.1 The existing baseline environmental conditions are defined to enable the assessment of changes or impacts that would be caused by the Scheme on the existing scenario. The identification of the baseline requires the description of the existing situation and then a prediction of how it is likely to evolve in the absence of the Scheme, i.e. 'future baseline scenario' based on available environmental information and scientific knowledge.

4.8.2 This includes taking into account current conditions and potential future development and using experience and professional judgment to predict what the baseline conditions might look like prior to the start of construction (2020) and operation (when the Scheme is first expected to open to traffic – 2022). The list of potential future development considered as part of both the future baseline and the cumulative scenarios is discussed within Chapter 15.

4.8.3 The description of the baseline conditions should clearly identify receptors that may be affected by the Scheme and their 'value' or 'sensitivity' to potential changes.

4.8.4 Where there are any potential differences in the 2020 and 2022 baseline conditions (both construction and operational phase), this is identified within the 'Future Baseline' sub-sections within the 'Baseline' and the 'Assessment of Effects' sections respectively for each of the topic chapters. Where the future baseline is inherent in the assessment methodology (e.g. for Air Quality and Noise and Vibration Chapters), the future baseline is not considered separately.

4.8.5 For the Air Quality and Noise and Vibration assessments, the absence and presence of the Scheme are referred to as the 'Do Minimum' and 'Do Something' scenarios respectively. The 'Do Minimum' scenario represents the future baseline without improvements at M2 Junction 5. The 'Do Something' scenario represents the scenario where the Scheme is built.

4.8.6 The effects are assessed for the 'Do Minimum' and 'Do Something' scenarios during construction, in the opening year and in a future assessment year. For example, assessments might be undertaken for 15 years after opening, or the worst year in the first 15 years of operation.

4.8.7 The current implementation strategy proposes that, subject to the planning application being accepted, main construction works would commence in 2020. The main works would be completed such that the site would become operational in 2022.

4.9 Identification of potential effects

4.9.1 Schedule 4 Part 1 Regulation 20, of the EIA 2017 Regulations requires:

'A description of the likely significant effects of the development on the environment, which should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the development, resulting from:

- The existence of the development;
- The use of natural resources;
- The emission of pollutants, the creation of the nuisances and the elimination of waste; and
- The description by the applicant of the forecasting methods used to assess the effects on the environment'.

4.9.2 A range of environmental topics may be affected by the Scheme. Effects may be negative or positive, temporary or permanent. They may also be described as:

- **Direct or Primary**: caused by activities which are an integral part of the proposals resulting in a change in environmental conditions, such as construction works causing an increase in dust concentrations in the air;
- **Indirect or Secondary**: due to activities that affect environmental conditions or the receptors, which in turn affects other aspects of the environment or receptors;
- **Cumulative**: comprising multiple effects from different sources within the proposals (synergistic or interrelationships), or cumulatively with other developments (additive), on the same receptors; and
- **Residual**: effects that remain after the positive influence of mitigation measures are taken into account.

4.9.3 Each of these effects can persist over a period of time and can be considered as:

- Temporary (e.g. demolition and construction phase);
- Short-term (< 5 years);
- Medium-term (5-10 years);
- Long-term (> 10 years); or
- Permanent (e.g. once the proposed works are completed and operational).

4.10 Design and mitigation process

4.10.1 Mitigation is defined as "measures intended to avoid, reduce and, where possible, remedy significant adverse environmental effects" (DMRB Volume 11, Section 2, Part 7 HA 218/08). Enhancement measures are defined as "measures over and above normal mitigation" (Interim Advice Note (IAN) 125/15).

4.10.2 Proposals for mitigation follow the mitigation hierarchy of avoid, reduce, remedy and compensate. Incorporated mitigation includes best practicable measures, and construction environmental management procedures identified in the Outline Environmental Management Plan (OEMP) and design features that have been adapted to reduce or prevent impacts. Incorporated mitigation is included within the assessment.

4.10.3 During the Option Identification Stage, the need for eliminating or mitigating any adverse environmental impacts was considered. As discussed in Chapter 3 above, Option 12A included a new slip road that would extend directly through Chestnut Wood, an Ancient Woodland so the option was rejected. Option 12A

was revised to avoid the Ancient Woodland and a further two options were also developed. No other specific mitigation measures were identified at that stage as they would be developed fully during this Preliminary Design Stage. For the purposes of the ES, the mitigation for the Option Selection Stage is assumed to be included in the Scheme with further detail or other measures also included where they are available at the time of writing. Where possible, consideration has been given to reducing or avoiding adverse environmental impacts and these will be developed further during the Scheme development as an iterative process. Mitigation measures will be informed by survey data being collected for the purposes of the Preliminary Design Stage and developed in consultation with statutory bodies. The Scheme will include all mitigation considered necessary to reduce effects to an acceptable level and the assessment will report on this basis. As well as mitigation, the Scheme will also include compensation for adverse effects where necessary and again the assessment will be based on the Scheme with this included.

4.10.4 During construction, the responsibility for further environmental mitigation and the adherence to environmentally responsible working practices will fall to the Principal Contractor. An OEMP has been prepared (see Appendix A in Volume 2) by the designer (Atkins) during this Preliminary Design Stage and will be refined as the Scheme progresses from development to construction and handover. The OEMP details practices that the Principal Contractor is to apply on-site that will demonstrate commitments to environmental management. It details both generic and specifically targeted practices to enable construction to be undertaken with minimal impact on the environment and will also enable monitoring requirements to be set up. A record of Environmental Actions and Commitments (REAC) identifying the environmental commitments to address potential environmental effects of the Scheme is included in the OEMP in Appendix A in Volume 2.

4.11 Assessment of effects

Assessment of significance

4.11.1 The significance of an environmental effect is typically a function of the ‘value’ or ‘sensitivity’ of the receptor and the ‘magnitude’ or ‘scale’ of the impact. Combining the environmental value of the resource or receptor with the magnitude of change produces a significance of effect category. In arriving at the significance of effect, the assessor also considers whether the effect is direct, indirect, secondary, cumulative, short, medium or long-term, permanent or temporary, positive or negative.

4.11.2 Methods and requirements specific to each assessment topic are set out in the relevant topic chapters (ES Volume 1 Chapters 5 to 15), however, the proposed general approach will be adopted in accordance with relevant guidance and best practice.

4.11.3 With the receptors identified and their sensitivity classified, the potential impacts of the proposed works to these aspects, for construction and operation where appropriate, will be determined and the magnitude of the impact determined.

4.11.4 In accordance with guidance in DMRB Volume 11, Part 5, for each topic the assessment will combine the magnitude of the impacts and the sensitivity of the resources/receptors that could be affected in order to classify the effect (see Table 4.1) to establish their significance (from very large to neutral). General descriptors for the significance of effect are provided in Table 4.2.

Table 4.1: Significance of effects

Sensitivity of receptor	Magnitude of impact				
	Major	Moderate	Minor	Negligible	No change
Very high	Very large	Large or very large	Moderate or large	Slight	Neutral
High	Large or very large	Moderate of large	Slight or moderate	Slight	Neutral
Medium	Moderate or large	Moderate	Slight	Neutral or slight	Neutral
Low	Slight or moderate	Slight	Neutral or slight	Neutral or slight	Neutral
Negligible	Slight	Neutral or slight	Neutral or slight	Neutral	Neutral

Table Source: Volume 11 Section 2 Part 5 HA 205/08

Table 4.2: Descriptors of the significance of effect categories

Significance category	Typical descriptors of effect
Very Large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Large	These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process.
Moderate	These beneficial or adverse effects may be important but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.
Slight	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process but are important in enhancing the subsequent design of the project.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Table Source: Volume 11 Section 2 Part 5 HA 205/08

4.11.5 Whilst the criteria derived vary between disciplines (from a very formal set of criteria based on nationally recognised standards for air quality, to more qualitative criteria derived to assess landscape impact or heritage) each specialist will have used the common terminology set out above alongside their topic-specific guidance and their professional judgement to assess the significance of effects. Effects that are moderate, large or very large are

generally deemed to be significant; slight or neutral effects are not significant. However, where this deviates, and an alternative basis of assessment applies, this is explained in the appropriate chapter.

Residual effects

4.11.6 Residual effects refer to those environmental effects predicted to remain after the application of mitigation and enhancement measures outlined in each environmental topic. The predicted residual effects are considered for each phase of the Scheme (construction and operation). In accordance with the criteria established in Table 4.2 above, significance has been determined for each residual effect.

4.12 Cumulative effects

4.12.1 Schedule 4, Regulation 5(e), of EIA 2017 Regulations requires an ES to include the assessment of cumulative effects. Cumulative effects are the result of multiple actions on environmental receptors. There are principally two types of cumulative impact:

- The combined action of a number of different environmental topic specific impacts upon a single resource/receptor (synergistic or interrelationships); and
- The combined action of a number of different projects, in combination with the project being assessed, on a single resource/receptor (additive).

4.12.2 Further details on the scope of the assessment is provided in Chapter 15. The EIA 2017 Regulations refer to the cumulation of impacts with other development. Therefore, the environmental effects of the Scheme will also be assessed in combination with the effects of other projects as part of the EIA process, where relevant information is available. Which projects should be considered as part of a 'cumulative' assessment for these purposes is not defined in the EIA Directive or Regulations and there is no standard approach to the assessment of cumulative effects, with different projects adopting different approaches. However, potential cumulative impacts with other major developments need to be identified, as required by the Directive. To aid this, the Planning Inspectorate's Advice Note 17[26] has been used as a guide and suggests the categories of developments that should be included in such cumulative assessments.

4.12.3 The cumulative assessment for the Scheme therefore includes developments which fall into the following categories but are not necessarily limited to:

- Trunk road and motorway projects which have been confirmed (i.e. gone through the statutory processes);
- Development projects with valid planning permissions as granted by the Local Planning Authority, and for which formal EIA is a requirement or for

[26] Planning Inspectorate, December 2015. Advice Note Seventeen: Cumulative Effects Assessment

which non-statutory environmental impact assessment has been undertaken;

- Applications for consent which have been made, but which have not yet been determined (see thresholds below);
- Allocated sites in emerging or adopted Local Plans; and
- Other types of application which could have implications for the Scheme.

4.12.4 Using these categories, developments have been identified with reference to local knowledge, published information and consultation with local planning authorities in the area.

4.12.5 Further details on the scope of the cumulative effects assessment is provided in Chapter 15 Assessment of Cumulative Effects.

4.13 Monitoring

4.13.1 In accordance with the EIA 2017 Regulations, monitoring requirements and procedures for the construction and operation of the Scheme are recommended, based on the requirement to maintain the current standard of the surrounding environment and to ensure the Scheme does not contribute to the degradation of the surrounding environment. The objectives of carrying out monitoring include:

- Providing a database against which any short- or long-term environmental impacts of the Scheme can be determined;
- Providing an early indication should any of the environmental control measures or practices fail to achieve acceptable standards;
- Monitoring the performance of the Scheme and the effectiveness of mitigation measures;
- Verifying the environmental impacts predicted in the Environmental Statement;
- Determining the Scheme's compliance with regulatory requirements, standards and government policies;
- Taking remedial action if unexpected problems or unacceptable impacts arise; and
- Providing data to enable an environmental audit.

4.14 Summary

4.14.1 Provision of a summary of the assessment and any significant effects.

4.15 Vulnerability to major accidents and disasters

4.15.1 The EIA 2017 Regulations introduced a requirement to consider significant adverse effects of the Scheme on the environment deriving from the vulnerability of the Scheme to risks of major accidents and/or disasters relevant to the Scheme.

4.15.2 The scope, methodology and findings of the screening assessment to assess the Schemes vulnerability to major accidents and disasters is provided below. The results of the screening assessment have (where applicable) been taken forward to be assessed in the topic chapters (Chapters 5 - 15).

4.15.3 The general scope of the assessment covers:

- Vulnerability of the Scheme to risks of major accidents and/or disasters that are relevant to the Scheme (subsequently referred to as major events);
- Identification of any consequential significant adverse environmental effects from those major events; and
- Measures to prevent or mitigate the significant adverse environmental effects of those major events and details of the preparedness for and response to such major events.

4.15.4 The assessment of major events:

- Applied professional judgement in consultation with Highways England to develop Scheme specific definitions of major events;
- Identified any major events that are relevant to and can affect the Scheme;
- Where major events are identified, described the expected significant effects arising from the vulnerability of the Scheme to the events;
- Reported the conclusions of this assessment within the individual environmental topic chapters; and
- Clearly described any assumed mitigation measures and details of the preparedness for and proposed response to such emergencies, to provide an evidence base to support the conclusions and demonstrate that likely effects have been mitigated/managed to an acceptable level.

4.15.5 The definition of a major accident used in this assessment is contained in the Control of Major Hazards Accident Regulations 2015 (COMAH) which define a "major accident" as an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment, and leading to serious danger to human health or the environment (whether immediate or delayed) inside or outside the establishment, and involving one or more dangerous substances. The terms which define a major accident are as follows:

- Injury to persons and damage to property:
  - A death;
  - Six persons injured within the establishment and hospitalised for at least 24 hours;
  - One person outside the establishment hospitalised for at least 24 hours;
  - A dwelling outside the establishment damaged and unusable as a result of the accident;
  - The evacuation or confinement of persons for more than 2 hours where the value (persons × hours) is at least 500; or

  - The interruption of drinking water, electricity, gas or telephone services for more than 2 hours where the value (persons × hours) is at least 1,000.
- Immediate damage to the environment:
  - Permanent or long-term damage to terrestrial habitats:
    - 0.5 ha or more of a habitat of environmental or conservation importance protected by legislation; or
    - 10 ha or more of widespread habitat, including agricultural land.
- Significant or long-term damage to freshwater and marine habitats:
  - 10 km or more of river or canal;
  - 1 ha or more of a lake or pond;
  - 2 ha or more of delta;
  - 2 ha or more of a coastline or open sea; or
  - Significant damage to an aquifer or underground water of 1 ha or more.
- Damage to property:
  - Damage to property in the establishment, to the value of at least EUR 2,000,000; or
  - Damage to property outside the establishment, to the value of at least EUR 500,000.

4.15.6 Key terms used in the assessment are listed below.

Table 4.3: Assessment terminology – vulnerability to major accidents and disasters

Significance category	Typical descriptors of effect
Major accident	The COMAH 2015 regulations define a 'major accident' as an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment and leading to serious danger to human health or the environment (whether immediate or delayed) inside or outside the establishment and involving one or more dangerous substances.
Natural disaster	A naturally occurring event such as extreme weather (storm, flooding) or a ground-related hazard event (subsidence, landslide, earthquake) with the potential to cause an event or situation that meets the definition of a major accident.
Risk	The likelihood of an impact occurring combined with the effect or consequence(s) of the impact on a receptor(s) if it does occur.
Risk event	An identified unplanned event which is considered relevant to the Scheme and has the potential to be a major accident or natural disaster subject to the identification of its potential to result in a significant adverse effect on an environmental receptor.
Serious damage	Serious damage includes the loss of life, permanent injury and temporary or permanent damage/destruction of an environmental receptor.

Significance category	Typical descriptors of effect
Vulnerability	In the context of environmental risk assessment, the term refers to the 'exposure and resilience' of the Scheme to the risk of a major accident or natural disaster.

4.15.7 By the above definitions, a significant adverse effect is considered to mean the loss of life or permanent injury, and/or permanent or long lasting damage to an environmental receptor. The significance of this effect takes into account the extent, severity and duration of harm and the importance and sensitivity of the receptor.

4.15.8 The potential effects resulting from major events and any consequences for receptors is reported (where applicable) in the individual environmental topic chapters (Chapters 5 - 15) and as such, vulnerability to major accidents and disasters is not a topic in itself.

4.15.9 Relevant major events are reported in this section and any consequences for receptors are reported in each of the individual environmental topic chapters.

Methodology

4.15.10 At the time of writing there is no published or adopted guidance for the assessment of major accidents and disasters. However, the methodology presented below is considered to provide an appropriate approach to the assessment.

4.15.11 The methodology adopted includes three main stages, as follows:

- Stage 1: a long list of all possible major events was developed. This list drew upon a variety of sources, including the UK Government's Risk Register of Civil Emergencies. Major events with little relevance in the UK were not included. Stage 1 also included an initial review of potential receptors to identify any groups that were not considered necessary to include in the assessment;
- Stage 2: a screening exercise was undertaken to review the long list of major events and to give consideration to their relevance to the Scheme and therefore whether they should be included on the Scheme specific short list of major events requiring further consideration. The study area for relevant major events was identified to be within 2 km of the Scheme; and
- Stage 3: where further design mitigation is unable to remove the potential interaction between a major event and a particular topic, the relevant Environmental Statement chapter identifies the potential consequence for receptors covered by the topic and gives a qualitative evaluation of the potential for the significance of the reported effect to be increased as a result of a major event.

Assessment findings

Stage 1

4.15.12 The long list of major events is provided in Appendix L in Volume 2.

Stage 2

4.15.13 In general, major events, as they relate to the Scheme, fall into three categories:

- Events that could not realistically occur due to the type of Scheme or its location;
- Events that could realistically occur but for which the Scheme and associated receptors are no more vulnerable than any other development; and
- Events that could occur and to which the Scheme is particularly vulnerable or has a particular capacity to exacerbate.

4.15.14 A screening stage was undertaken to try to identify this third group of major events, which then formed the shortlist of events to be taken forward for further consideration.

Stage 3

4.15.15 Stage 2 of the assessment resulted in a short list of major events that are considered to need further consideration at Stage 3, though this may only mean that the risk needs to remain on the design risk register until it is closed out through design. Specific major events that have been included on the short list and are considered in more detail are presented in Table 4.4 below.

Table 4.4: Major events shortlisted for further consideration

Major event	Reason for consideration	Potential receptors	Consequence	Mitigation
Geological disasters				
Sinkholes	Due to the geology underlying the Scheme (Chalk) there is a possibility that sink holes may form within the vicinity of the Scheme.	Road users, infrastructure and property, surrounding environment.	Casualties, damage to infrastructure and property, disruption to services.	Within the Ground Investigation and Scheme design. The risk can be mitigated through design. There is a risk that the cost of construction may increase due to additional mitigation.
Ground instability	Geological hazards causing instability of the ground surrounding the Scheme.	Road users, infrastructure and property, surrounding environment.	Casualties, damage to infrastructure and property, disruption to services.	Within the Ground Investigation and Scheme design. The risk can be mitigated through design. There is a risk that the cost of construction may increase due to additional mitigation.
Engineering accidents/failures				
Utilities failure (gas, electricity, water, sewage, oil, communications)	Numerous utility routes cross Scheme area could fail and cause damage to the Scheme. Some utility routes may require diversion during construction of the Scheme increases the risk of failure during diversion.	Road users, local residents, property, surrounding environment.	Potential for fire/explosion, pollution incident, injury.	All utilities companies have plans and arrangements in place to deal with supply disruptions and failures.
Industrial accidents				
Mining industry	Historical mining and quarrying activities have been identified within the vicinity, there is potential that these and any unrecorded mineral extraction activities could cause ground instabilities or cause sink holes to form.	Road users, infrastructure and property, surrounding environment.	Casualties, damage to infrastructure and property, disruption to services.	Within the Ground Investigation and Scheme design. The risk can be mitigated through design. There is a risk that the cost of construction may increase due to additional mitigation.
Terrorism/crime/civil unrest				
Cyber attack	The increasing reliance on roadside technology could render the Scheme more vulnerable to a cyber attack.	Road users.	Accidents due to information boards displaying incorrect information, fatalities.	The roadside technology is designed to Highways England security arrangements to mitigate the effects of cyber attacks.

4.16 Dealing with uncertainty

4.16.1 EIA is an iterative process and the Scheme may include somewhat uncertain aspects. At the time that the ES is submitted, it is proposed that no aspects of design would vary so much as to represent effectively different schemes. The EIA would ensure it addresses the potential for a range of impacts resulting from any undecided parameters.

4.16.2 The Rochdale Envelope principle would be applied in accordance with the Planning Inspectorate's Advice Note 9: Using the Rochdale Envelope (Planning Inspectorate, 2012). The ES will assume the 'worst case' clearly explaining any elements of the Scheme yet to be finalised, with justification. Where flexibility is sought in the Scheme design, the maximum potential adverse impacts of the Scheme will be assessed. The ES will confirm maximum and other dimensions of the Scheme and that any changes to the development within such parameters would not result in significant impacts not previously identified and assessed.

4.17 Transboundary impact screening

4.17.1 Regulation 24 of the IP (EIA) Regulations 2017 requires PINS to notify other European Economic Area (EEA) States and publicise an application for development consent if it is of the view that the proposed development is likely to have significant effects on the environment of another EEA Member State, and where relevant to consult with the EEA State affected. The Scheme is approximately 86 km from France, the closest EEA State.

4.17.2 The study areas for the various environmental topics define the extent of effects anticipated and are described fully in Chapters 5 to 15.

4.17.3 As none of these distances reach other EEA Member States, no transboundary effects are anticipated for the Scheme and therefore not considered further.

4.18 Health impact assessment and equalities impact assessment

4.18.1 The assessment of the effect of the Scheme on population and human health is a requirement under the EIA 2017 Regulations. Coverage of health in the ES will not equate to a full Health Impact Assessment (HIA) but will be informed by good practice guidance for HIA. Human health in this ES will principally be assessed in the Population and Human Health chapter (Chapter 13), using the sub-topics scoped in to this chapter as a basis for the assessment. Health effects will also be considered in each topic chapter as relevant to that assessment, for example, Air Quality and the effects of the Scheme on health issues relating to air quality.

4.19 Habitat regulations screening

4.19.1 A Habitat Regulation Assessment (HRA) Stage 1: Screening has been undertaken in accordance with DMRB guidance. This is due to the proximity of North Downs Woodland SAC and Peters Pit SAC to the ARN. The HRA Stage 1: Screening has been undertaken to assess if there would be likely significant effects on the SAC's. The HRA Stage 1 Screening report is presented in Appendix D.6 in Volume 2. Natural England have been consulted and have provided a formal consultation response, which concurs with the suitability of the

methodology and conclusions of the screening assessment that there is no potential for a likely significant effect on any European site.

4.20 Climate change

4.20.1 In the ES, climate change will be covered in line with the new requirements for climate as outlined in the EIA Regulations 2017. The scope of the assessment will cover:

- Effects on climate (for example greenhouse gas emissions); and
- Vulnerability of the project to climate change (and impacts relevant to adaptation).

4.21 Sustainability

4.21.1 Sustainability has been embedded throughout the planning and design process to drive progressive performance improvement. This approach has included early engagement with project and programme design and assessment specialists, and the development of a formal sustainability framework with associated objectives, indicators and targets based around Highways England's Sustainable Development Strategy. The embedded sustainability process has brought together the wider sustainability agenda and influenced the design optioneering process by identifying opportunities early and allocating accountability to key individuals, with the sustainability framework as the key tool. The developed framework has enabled the team to remain energised, as sustainability is a collective responsibility. Everyone involved in the design process was briefed on the sustainability requirements and enabled to challenge the design to exceed the requirements. The core function of the sustainable design process has been to embed, drive and document outcome-focused performance improvement in a systematic and efficient way.

4.21.2 The key to implementing this approach was integration and close collaboration between the sustainability, environmental assessment and design teams, i.e. enabling project teams to understand what is required and how they can deliver within the resources they have available, but also in separate discipline areas, including air quality, cultural heritage, landscape, biodiversity, waste and materials, noise and vibration, climate change mitigation and adaptation and socio-economic effects. This was achieved through early engagement between a dedicated sustainability team and the project team and specific sustainability meetings between the sustainability team and each design discipline at certain stages of the design process. This culminated in a log tracking how and when the design has been challenged and where and at what stage sustainability has been improved and incorporated into the design. The embedded sustainability process has provided clarity, assigned practical actions at project level and avoided mystifying sustainability subjects. This has helped make sustainable planning/design simple, developing a process within which to challenge the teams and drive them to achieve the best sustainability performance.

4.21.3 The sustainability framework has been used to help drive sustainability performance improvements via proactive optioneering, as well as collate and synthesise key evidence to support this. This integrated, collaborative process also ensures technical specialists are in place to work closely with the project

team to ensure team members understand the required sustainability outcomes and take ownership of actions. This innovative approach to sustainability has enabled unification between sustainability outputs from across the disciplines, aligned outcomes, influenced decisions and generated further innovation.

5. Air Quality

5.1 Introduction

5.1.1 This chapter provides the air quality assessment of the Scheme. It identifies and presents the existing baseline air quality conditions in the Scheme area, identifies the potential impacts of air quality associated with the Scheme on human health and ecosystems both during construction and operation, and discusses mitigation measures that may be applied to mitigate any potentially significant adverse effects.

5.2 Competent expert evidence

5.2.1 This Air Quality chapter has been undertaken by Victoria Sykes who is a chartered scientist (BSc, CSci) and holds full professional membership with the Institution of Air Quality Management. She has over 20 years of knowledge and experience in air quality assessment and has used her knowledge and professional judgement to undertake this assessment.

5.3 Legislative and policy framework

5.3.1 There are two sets of air quality criteria for the protection of public health: legally binding, mandatory limit values set by the European Union (EU); and objectives set out in the UK National Air Quality Strategy (AQS)[27], which local authorities are required to work towards achieving. Both sets of criteria are implemented in Air Quality Regulations (The Air Quality Standards Regulations 2010 (SI 2010/1001)[28] for EU limit values, and The Air Quality (England) Regulations (SI 2000/928)[29] and The Air Quality (England) (Amendments) Regulations (SI 2002/3043 for AQS objectives)[30].

5.3.2 Air quality criteria relevant to the air quality assessment are summarised in Table 5.1. These criteria for nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) are the same for both the EU limit values and the AQS objectives.

Table 5.1: Relevant human health air quality criteria

Pollutant	Criteria
NO_2	1-hour mean concentration should not exceed 200 µg/m³ > 18 times a year
	Annual mean concentration should not exceed 40 µg/m³
PM_{10}	24-hour mean concentration should not exceed 50 µg/m³ > 35 times a year
	Annual mean concentration should not exceed 40 µg/m³
$PM_{2.5}$	Annual mean concentration should not exceed 25 µg/m³

[27] DEFRA (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. [Online] Available from: https://www.gov.uk/government/publications/2010-to-2015-government-policy-environmental-quality/2010-to-2015-government-policy-environmental-quality#appendix-5-international-european-and-national-standards-for-air-quality [Accessed 2018]
[28] The National Archives (2010) The Air Quality Standards Regulations 2010: [Online] Available from: http://www.legislation.gov.uk/uksi/2010/1001/contents/made [Accessed 2018]
[29] The National Archives (2000) The Air Quality (England) Regulations 2000: [Online] Available from: http://www.legislation.gov.uk/uksi/2000/928/contents/made[Accessed 2018]
[30] The National Archives (2002) The Air Quality (England) (Amended) Regulations 2002: [Online] Available from: http://www.legislation.gov.uk/uksi/2002/3043/contents [Accessed 2018]

Ecological criteria

5.3.3 The EU Directive sets a critical level for annual mean concentrations of nitrogen oxides (NO_X) to protect sensitive vegetation. This is included in the Air Quality Standards Regulations (SI 2010/1001)[28]. Assessment of compliance with this critical level is undertaken at locations more than 20 km from towns with more than 250,000 inhabitants or more than 5 km from other built-up areas, industrial installations or motorways or major roads with traffic counts of more than 50,000 vehicles per day. UK statutory nature conservation agencies' (Natural England) policy is to apply the criterion of 30 µg/m^3, on a precautionary basis, as a benchmark only in all designated conservation sites, including Ramsar sites, Special Protection Areas (SPAs), Special Area of Conservation (SACs) and Sites of Special Scientific Interest (SSSIs).

5.3.4 Critical loads for nitrogen deposition have been set by the United Nations Economic Commission for Europe (UNECE)[31]. A critical load is a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur, according to present knowledge. Critical loads vary by type of habitat and species. The critical load for deposition is given as a range and is quoted in units of kg/ha/year.

Dust deposition

5.3.5 There are no national standards or guidelines for dust deposition currently set for the UK, nor by the European Union or any international organisation. This is mainly due to the difficulty in setting a standard that needs to relate to dust normally being a perceptual problem rather than related to health effects. Typically, assessments use an indicative threshold for the 'likelihood of complaint' for instance, in residential areas a dust deposition flux (as an average measured over a month using a passive deposition gauge) of 200 mg/m^2/day or greater.

Planning policy and framework

5.3.6 Table 5.2 below summarises the legislation, regulatory and policy framework applicable to air quality.

Table 5.2: Legislation, regulatory and policy framework for air quality

Scale	Legislation/ regulation	Summary of requirements
National	National Planning Policy Framework (NPPF) 2019[32]	Paragraph 181 of the NPPF requires local planning authorities (LPAs) to take account of air quality in plan making. Paragraph 181: "Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas (AQMAs) and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to

[31] UNECE, "Convention on Long-range Transboundary Air Pollution," [Online]. Available from: https://www.unece.org/env/lrtap/welcome.html.html. [Accessed October 2018].
[32] MHCLG (2019) National Planning Policy Framework. [Online]. Available from: https://www.gov.uk/government/publications/national-planning-policy-framework--2 [Accessed 2019]

Scale	Legislation/ regulation	Summary of requirements
		improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."
	National Networks National Policy Statement (NN NPS) 2014[33]	The NN NPS provides policy and guidance relating to the development of NSIPs. It recognises (paragraph 5.3) that increased emissions of pollutants during construction or operation of projects on national networks can contribute to adverse impacts on human health, on protected species and habitats. An ES is required for projects that may have significant air quality effects and this should describe (paragraph 5.7): • Existing air quality levels; • Forecasts of air quality at the time of opening, assuming that the Scheme is not built (the future baseline) and taking account of the impact of the Scheme; and • Any significant air quality effects, their mitigation and any residual effects, distinguishing between the construction and operation stages and taking account of the impact of road traffic generated by the project. Paragraphs 5.11, 5.12 and 5.13 of the NN NPS requires a judgement to be made as to the risk of a project affecting the UK's ability to comply with the Air Quality Directive. Paragraph 5.11: "Air quality considerations are likely to be particularly relevant where schemes are proposed: within or adjacent to AQMAs; roads identified as being above Limit Values or nature conservation sites; and where changes are sufficient to bring about the need for a new AQMA or change the size of an existing AQMA; or bring about changes to exceedances of the Limit Values, or where they may have the potential to impact on nature conservation sites." Paragraph 5.12: "The Secretary of State must give air quality considerations substantial weight where, after taking into account mitigation, a project would lead to a significant air quality impact in relation to EIA and/or where they lead to a deterioration in air quality in a zone/agglomeration." Paragraph 5.13: "The Secretary of State should refuse consent where, after taking into account mitigation, the air quality impacts of the Scheme will: result in a zone/agglomeration which is currently reported as being compliant; or affect the ability of a non-compliant area to achieve compliance with the most recent timescales reported to the European Commission at the time of the decision."
	The Air Quality Strategy for	Sets out air quality standards and objectives, to protect people's health and the environment.

[33]DfT (2014) National Policy Statement for National Networks. [Online] https://www.gov.uk/government/publications/national-policy-statement-for-national-networks [accessed 2018]

Scale	Legislation/ regulation	Summary of requirements
	England, Scotland, Wales and Northern Ireland (AQS) 2007[34]	
	The Air Quality (Standards) Regulations 2010 (SI 2010/1001)	English legislation which sets legally binding limit values for human health and vegetation set in Directives 2008/50/EC and 2004/107/EC on ambient air quality.
	The Air Quality (England) Regulations 2000 (SI 2000/928) and The Air Quality (England) (Amendments) Regulations (SI 2002/3043)	English legislation which sets the objectives given in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland, applicable to local air quality management.
	Environment Act 1995 (Part IV)	Sets provisions for protecting air quality in the UK and for local air quality management. Local authorities are required to regularly review and assess local air quality and identify areas where AQS objectives may be exceeded. Where the authority has declared an AQMA, it is required to prepare an Air Quality Action Plan (AQAP) describing pollution reduction measures it will put in place.
	Road Investment Strategy (RIS) and Strategic Business Plan 2015[35]	By 2040 DfT aspires to a network that will be sustainable with “zero breaches of air quality regulations and major reductions in carbon emissions across the network”.
	Highways England Delivery Plan 2015-2020[36] and 2017-2018[37]	The Highways England Delivery Plan 2015-2020 identifies Highways England’s commitment to investing £75m “in a range of projects to reduce pollution and ensure the air around the network is clean and healthy”. The Highways England Delivery Plan 2017-2018sets out indicators that will be used to measure performance, including, of relevance to air quality, the number of air quality pilot studies completed.
	Highways England Air Quality Strategy 2017[38]	Sets out Highways England’s approach to improving air quality. As part of the strategy, Highways England has identified four priority action areas; policy, planning, monitoring and operational management, and has committed to “where appropriate, design out or mitigate poor air quality for our schemes”

[34] DEFRA (2007), The Air Quality Strategy for England, Scotland, Wales and Northern Ireland [Online] https://www.gov.uk/government/publications/the-air-quality-strategy-for-england-scotland-wales-and-northern-ireland-volume-1 [Accessed 2018]
[35]DfT and Highways Agency (2015) Road Investment Strategy: for the 2015/16 - 2019/20 Road Period, March 2015. [Online] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/408514/ris-for-2015-16-road-period-web-version.pdf [Accessed 2018]
[36] Highways England (2015) Highways England Delivery Plan 2015 - 2020. [Online] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/424467/DSP2036-184_Highways_England_Delivery_Plan_FINAL_low_res_280415.pdf [Accessed 2018]
[37]Highways England (2017) Highways England Delivery Plan 2017-2018. [Online] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/642750/Highways_England_Delivery_Plan_Update_2017-2018.pdf [Accessed 2018]
[38] Highways England (2017) Our strategy to improve air quality. [Online] https://www.gov.uk/government/publications/highways-england-air-quality-strategy [Accessed 2018]

Scale	Legislation/ regulation	Summary of requirements
	National Air Quality Plan 2017[39]	The UK government's plan for tackling UK roadside nitrogen dioxide concentrations which sets out the approach for meeting the statutory EU limit values for nitrogen dioxide in the shortest possible time.
	Clean Air Strategy 2019[40]	National strategy setting out the actions required across all parts of government and society to improve air quality. It includes new goals to reduce public exposure to $PM_{2.5}$ as recommended by the World Health Organisation.
Local	Maidstone Borough Local Plan 2017[41]	Policy SP 23 Sustainable Transport aims to address the air quality impact of transport through the council's Integrated Transport Strategy. Policy DM 6 Air Quality requires the potential impact on air quality from development proposals to be assessed and to consider mitigation measures. Policy DM 21 Assessing the Transport Impacts of Development notes that development proposals need to comply with Policy DM6.
	Maidstone Town Air Quality Action Plan 2010[42]	The Air Quality Action Plan describes the pollution reduction measures it will put in place. The primary focus is on achieving modal shift to walking, cycling, public transport and low emission transport.
	Maidstone Low Emission Strategy (2017)[43]	The strategy fulfils the requirements of an Air Quality Action Plan and aims to improve air quality by reducing vehicle emissions through various measures including introducing emissions standards for buses and taxis, promoting electric vehicles, and the use of planning.
	The Swale Borough Local Plan (2017)[44]	Policy DM 6 Managing transport demand and impact notes the need to ensure development proposals do not worsen air quality to an unacceptable degree.
	Swale Borough Council Air Quality Action Plan (2018 - 2022)[45]	The Air Quality Action Plan sets out the proposed measures for improving air quality across the borough and within the AQMAs which focus on reducing vehicle emissions.
	Medway Local Plan (2003)[46]	Policy BNE 24 Air Quality notes that an assessment should be made to determine the impact on air quality for development likely to result in emissions to air.

[39]Defra (2017) UK plan for tackling roadside nitrogen dioxide concentrations. [Online] https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017 [Accessed 2018]
[40]Defra (2019) Clean Air Strategy 2019 [Online] https://www.gov.uk/government/publications/clean-air-strategy-2019 [Accessed 2019]
[41]Maidstone Borough Council (2017) Maidstone Borough Local Plan [Online] http://services.maidstone.gov.uk/docs/October%202017%20Adopted%20Local%20Plan.pdf [Accessed 2018]
[42]Maidstone Borough Council (2010) Maidstone Town Air Quality Action Plan 2010 [Online] http://aqma.defra.gov.uk/action-plans/MBC%20AQAP%202010.pdf [Accessed 2018]
[43]Maidstone Borough Council (2017) Maidstone Low Emission Strategy [Online] http://www.maidstone.gov.uk/__data/assets/pdf_file/0010/164674/Low-Emissions-Strategy-December-2017.pdf [Accessed 2018]
[44]Swale Borough Council (2017) Bearing Fruits 2031 The Swale Borough Local Plan [Online] http://services.swale.gov.uk/media/files/localplan/adoptedlocalplanfinalwebversion.pdf [Accessed 2018]
[45]Swale Borough Council (2018) Swale Borough Council Air Quality Action Plan (2018 – 2022) [Online] https://services.swale.gov.uk/meetings/documents/s11020/Appendix%20I%20AQAP_SwaleBC_2018%20nv%202.pdf [Accessed 2019]
[46]Medway Council (2003) Medway Local Plan 2003 [Online] https://www.medway.gov.uk/downloads/file/2400/medway_local_plan_2003 [Accessed 2018]

Scale	Legislation/ regulation	Summary of requirements
	Medway Council Air Quality Action Plan (2015)[47]	The Action Plan details twelve key measures for improving air quality in the AQMAs by reducing transport emissions. These measures include improving freight movement, encouraging public transport use and cycling and walking, traffic management, and procurement amongst others.

Table Source: Various

5.4 Study area

5.4.1 The air quality assessment study area is set in accordance with the DMRB Volume 11, Section 3, Part 1 HA 207/07 'Air Quality'[48].

5.4.2 The air quality study area for assessing the potential effects of construction dust during the construction phase is defined as the area within 200 m of the construction site, as set out in DMRB HA 207/07 (paragraph 3.45). For this Scheme the study area for construction includes the area within 200 m from the Scheme boundary.

5.4.3 The air quality study area for assessment of traffic during the operational phase is determined in accordance with traffic change criteria set out in the DMRB HA 207/07 which defines the affected road networks (ARN) for local (paragraph 3.12) and regional (paragraph 3.20) air quality assessments. An assessment is required for local air quality where there are receptors identified within 200 m of the ARN.

5.4.4 The study area for the local air quality assessment is situated within the administrative boundaries of Maidstone Borough Council, Swale Borough Council, and Medway Council; and includes the area within 200 m of the Scheme extent and the following affected roads: the M2, the A2 and the A249.

5.4.5 Figure 5.2 in Volume 3 shows the study area for construction dust. Figure 5.1 in Volume 3 shows the air quality constraints which includes sensitive human health receptors and designated ecological sites within 200 m of the ARN and includes the study area for local air quality during operation.

5.5 Assessment methodology

5.5.1 The air quality assessment for the Scheme has been undertaken following the guidance given in the DMRB HA207/07 and associated IANs and includes:

- Discussion of existing baseline conditions;
- Identification of sensitive receptors and AQMAs, and production of constraints maps;
- Qualitative assessment of the likely effect on local air quality during construction;

[47] Medway Council (2015) Medway Air Quality Action Plan 2015 [Online]. https://www.medway.gov.uk/downloads/file/1982/medway_air_quality_action_plan_2015 [Accessed 2018]
[48] DfT (2007). DMRB Volume 11, Section 3, Part 1 HA 207/07 'Air Quality'. [Online] Available from: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/ha20707.pdf [Accessed 2018]

- Assessment of the likely changes in local air pollutant concentrations and nitrogen deposition rates during operation at selected receptors;
- Assessment of significance of the air quality effects including an assessment of compliance with the EU Air Quality Directive;
- Assessment of the likely changes in regional emissions during operation; and
- Identification of the need for mitigation measures where appropriate.

Existing air quality information

5.5.2 A summary of existing air quality has been provided which updates the information previously collated for the Environmental Scoping Report (October 2018) to include the additional information for the revised study area.

Constraints map

5.5.3 A constraints map for the Scheme air quality study area has been produced and is shown in Figure 5.1 in Volume 3. The constraints map includes: affected roads, 200 m boundary from affected roads, sensitive receptors, AQMA boundaries, statutory designated ecological site boundaries, and exceedance areas of air quality criteria without and with the Scheme where known.

Effects on air quality during construction

5.5.4 A qualitative assessment of impacts on air quality from construction has been undertaken in accordance with the DMRB. The assessment has taken into account the nature of any proposed construction activities that have the potential to generate dust and the location of sensitive receptors within 200 m of the Scheme construction works that could be at risk of being affected.

5.5.5 A qualitative assessment of vehicle emissions during construction as a result of traffic management measures has also been undertaken.

Effects on air quality during operation

5.5.6 The air quality assessment has been undertaken following the relevant guidance given in the DMRB HA207/07 and associated IANs.

5.5.7 Due to the complexity of the Scheme and the potential for significant effects, a detailed local air quality assessment has been undertaken to estimate NO_2 and PM_{10} concentrations at selected human health receptors, and NO_X concentrations and rates of nitrogen deposition at designated ecological sites in the Scheme opening year. The local assessment is undertaken for the opening year, rather than the design year, as pollutant concentrations are likely to be higher in earlier years, due to continued expected improvements in emissions in future years.

5.5.8 A detailed level of assessment has been undertaken for regional emissions of NO_X, PM_{10} and CO_2 for the opening and design years, given that there were estimated to be changes in modelled peak hour speeds on the roads approaching Junction 5.

5.5.9 $PM_{2.5}$ is not included in the assessment as there is not considered to be a risk of the annual mean air quality criterion being exceeded. This is explained in more

detail in Appendix B.1 in Volume 2. However, measured concentrations at nearby monitoring sites are included in the baseline conditions section for information.

5.5.10 The key scenarios included in the assessment were:

- Base year (2016) – for model verification;
- Projected base year (2022) – for long-term trends assessment;
- Opening year (2022) – for both the without ('Do Minimum') and with Scheme ('Do Something'), local and regional assessments; and
- Design year (2037) – 'Do Minimum' and 'Do Something', regional assessment only.

5.5.11 Traffic data were provided from the strategic SATURN traffic model (provided by Atkins transport planners) to enable the ARN for the local air quality assessment to be determined.

5.5.12 An affected road, for the purposes of a local air quality assessment, is defined in DMRB HA 207/07 (paragraph 3.12) as a road that meets any of the following criteria:

- Road alignment will change by 5 m or more;
- Daily traffic flows will change by 1,000 annual average daily traffic (AADT) or more;
- Heavy Duty Vehicle (HDV)[49] flows will change by 200 AADT or more;
- Daily average speed will change by 10 km/hr or more; or
- Peak hour speed will change by 20 km/hr or more.

5.5.13 The changes are applied to roads, rather than modelled links, and so where relevant are determined under two-way traffic conditions. The affected roads are provided in Figures 5.3 to 5.8 in Volume 3.

Local air quality

5.5.14 The local air quality assessment was undertaken using the Atmospheric Dispersion Modelling System (ADMS) Roads dispersion modelling software (version 4.1.1.0). Representative receptors were selected for the local air quality assessment and include those closest to the ARN, and therefore likely to be most affected, as well as those likely to experience the highest concentrations. Receptors are provided in Appendix B .6 in Volume 2 and shown in Figure 5.9 in Volume 3. The hourly emissions data input to the dispersion model were estimated using Highways England speed band emission factors (Draft DMRB V6.1 based on EFT v8), hourly flows of Light Duty Vehicles (LDVs) and HDVs, during am, inter, pm and off peak periods, and speeds input as a speed category, as determined in accordance with IAN 185/15 on speed banding. In addition, information on road alignment, road width, and local meteorological data (taken from Gravesend meteorological station for the base year 2016, windrose shown in Section 5.8) were input into the dispersion model.

[49] Vehicles with a gross vehicle weight above 3.5 tonnes

Traffic conditions

5.5.15 Traffic conditions vary throughout the course of a day and between weekdays and weekends, hence 24-hour profiles for both weekday and weekend days have been applied in the model to improve the estimation of vehicle emissions in each hour of the year. The ADMS-Roads model was set up with a unit emission rate entered into the model for each road link and a time varying emissions file created containing the estimated emissions for each hour. Further details of the modelling approach are provided in Appendix B.2 in Volume 2.

Background concentrations

5.5.16 The output from the model provides estimates of the contribution from road traffic emissions to annual mean concentrations of NO_X and PM_{10} at discrete receptors. These concentrations were combined with estimates of background concentrations, to account for other sources of air pollution, to derive total annual mean concentrations. Background concentrations have been derived from Defra's background maps (2015 reference year) and compared with monitored data at background sites in the area where available, to ensure the mapped estimates are appropriate. The comparison is provided in Appendix B.3 in Volume 2, and showed that the mapped estimates for both NO_2 and PM_{10} were within 30% of the monitored concentrations and could be considered appropriate to use in the assessment.

5.5.17 To avoid double counting the contribution from modelled emission sources, the in-square contributions from motorways, trunk roads, and primary A roads, within Defra's background maps, were removed from the total background NO_2 concentration using the NO_2 Adjustment for NO_X sector removal tool v6.0, November 2017.

NO_X to NO_2 conversion

5.5.18 Annual mean concentrations of NO_2 were derived from NO_X concentrations using the most up to date version of DEFRA's NO_X to NO_2 calculator (version 6.1). The traffic mix and local authority data used for the conversion were selected according to the locations of the receptors.

Verification

5.5.19 The annual mean NO_2 concentrations for the base year were verified with comparison against available ratified monitoring data and adjusted where appropriate, with reference to Defra's LAQM.TG(16). Further details are provided in Appendix B.4 in Volume 2. Initially, the modelled results were found to be underestimating, therefore an adjustment factor of 1.65 was derived that was suitable to be applied throughout the air quality study area. Once adjusted, model performance was considered to be acceptable in accordance with Defra's LAQM.TG(16).

5.5.20 In the absence of monitored PM_{10} concentrations in the study area against which modelled concentrations could be verified, the model adjustment factor derived for NO_x was also applied to modelled PM_{10} concentrations. This approach is suggested within LAQM.TG(16) and is considered likely to provide a conservative estimate of the contribution of modelled roads to ambient PM_{10} concentrations.

Long-term trends

5.5.21 The assessment was undertaken in accordance with IAN 170/12 v3 on the assessment of future NO_X and NO_2 projections on long-term trends, to account for future year uncertainties in emissions. Air quality assessments following the latest Defra emission factors have been considered to be overly optimistic in some cases. IAN 170/12 v3 requires that steps are taken to adjust the estimated total NO_2 concentrations from modelling, termed 'gap analysis' in order to better reflect future trends. An additional scenario (projected base year) is required to enable the gap analysis to be completed. The projected base year scenario is modelled using the base year traffic data with the opening year vehicle emission factors and background concentrations. The results for the opening year are then adjusted to represent the observed long-term trend profile.

5.5.22 Analysis of trends in annual mean NO_2 concentrations has been undertaken using the Finnish Meteorological Institute MAKESENS (v1) spreadsheet using the annual time series data for relevant monitoring sites. The analysis identifies where there is a statistically significant trend in monitored annual mean NO_2 concentrations at sites with suitably robust data for use in the selection of long-term trend factors. In this case the analysis was carried out for all monitoring sites within the study area with sufficient data and continuous monitoring sites outside of the study area. In this case the Highways England LTTE6 projection factors are deemed to be the most appropriate, based on the monitoring data trend analysis as presented in Appendix B.5 in Volume 2, which showed that the majority of sites had a downward trend, which was deemed to be significant at two locations.

Compliance with EU limit values

5.5.23 Evaluation of compliance with EU limit values has been undertaken in accordance with IAN 175/13, using the baseline scenario from Defra's Pollution Climate Mapping (PCM) model.

Comparison with short-term objectives

5.5.24 Commentary on potential exceedances of the 1-hour mean NO_2 AQS objective is possible with reference to Defra's LAQM.TG(16). The guidance suggests that if annual mean concentrations of NO_2 do not exceed 60 µg/m^3 then it is unlikely that hourly mean concentrations would exceed the objective for the 1-hour mean.

5.5.25 Defra's LAQM.TG(16) was also used to derive the number of exceedances of the 24-hour mean PM_{10} AQS objective, of which 35 are permitted. The method is based on the relationship between the number of 24-hour exceedances of 50 µg/m^3 and the annual mean concentration derived from UK Automatic Network Sites. This is described in the equation below:

Equation 5.1 – Calculation of PM_{10} 24-hour mean exceedances

Number of exceedances of 24-hour mean of 50 µg/m^3 = -18.5 + 0.00145 *a^3 + (206/a)

Where 'a' = total annual mean PM_{10} concentration

Ecological assessment

5.5.26 Assessment of potential effects on NO_X concentrations and nitrogen deposition rates has been undertaken at identified sensitive ecological designations, in accordance with Annex F of the DMRB HA 207/07.

Magnitude of impact classification

5.5.27 Descriptors for magnitude of change in ambient concentrations of NO_2 and PM_{10} are provided in IAN 174/13. The changes in magnitude, which are based on an assumed measure of uncertainty (MoU) of 10%, may be described as imperceptible, small, medium or large, depending on the change in concentration relative to the air quality criterion as shown in Table 5.3.

Table 5.3: Magnitude of change criteria for local air quality

Magnitude of change in concentration	Value of change in annual mean NO_2 and PM_{10}
Large (>4 µg/m^3)	Greater than full MoU value of 10% of the air quality objective (4 µg/m^3).
Medium (>2 to 4 µg/m^3)	Greater than half of the MoU (2 µg/m^3), but less than the full MoU (4 µg/m^3) of 10% of the air quality objective.
Small (>0.4 to 2 µg/m^3)	More than 1% of the objective (0.4 µg/m^3) and less than half of the MoU i.e. 5% (2 µg/m^3). The full MoU is 10% of the air quality objective (4 µg/m^3).
Imperceptible (≤0.4 µg/m^3)	Less than or equal to 1% of objective (0.4 µg/m^3).

Significance

5.5.28 Evaluation of the significance of the effect of the Scheme on local air quality has been undertaken in accordance with IAN 174/13. The number of receptors that fall within the 'small', 'medium' and 'large' magnitude of change categories is calculated and compared to the guidelines presented in Table 5.4. Significant air quality effects are only identified for receptors where AQS objectives are exceeded with or without the Scheme. Where the changes in concentrations are less than 1% of the AQS objective (i.e. less than 0.4 µg/m^3) then the change at these receptors is considered to be 'imperceptible' and can be scoped out of the judgement on significance.

Table 5.4: Number of receptors constituting a significant effect for air quality

Magnitude of change in concentration	Number of receptors with	
	Worsening of air quality objective already above objective or creation of a new exceedance	Improvement of an air quality objective already above objective or the removal of an existing exceedance
Large (>4 µg/m^3)	1 to 10	1 to 10

Magnitude of change in concentration	Number of receptors with	
	Worsening of air quality objective already above objective or creation of a new exceedance	Improvement of an air quality objective already above objective or the removal of an existing exceedance
Medium (>2 to 4 µg/m^3)	10 to 30	10 to 30
Small (>0.4 to 2 µg/m^3)	30 to 60	30 to 60

Regional emissions

5.5.29 A detailed regional air quality assessment has been undertaken given that there are expected to be changes in peak hour speeds. Emissions of NO_X, PM_{10} and CO_2 were calculated for all the road links in the section of traffic model provided considered to be in the traffic reliability area. The key scenarios for assessment are:

- Base year (2016);
- Opening year (2022), for both the 'Do Minimum' and 'Do Something' cases; and
- Design year (2037), for both the 'Do Minimum' and 'Do Something' cases.

5.6 Assumptions and limitations

5.6.1 Any air quality model has inherent areas of uncertainty, including:

- The traffic data used in the air quality model;
- The suitability of emissions data;
- Simplifications in model algorithms and empirical relationships that are used to simulate complex physical and chemical processes in the atmosphere;
- The suitability of background concentrations; and
- The suitability of meteorological data.

5.6.2 Uncertainty associated with traffic data has been minimised by using a validated traffic model.

5.6.3 Uncertainties associated with emissions data have been minimised by using the most up to date speed-band emission factors available and by applying IAN 170/12 v3 for long-term trends.

5.6.4 Uncertainties associated with model algorithms and empirical relationships have been minimised by using algorithms and relationships that have been independently validated and judged as fit for purpose.

5.6.5 The suitability of using Defra mapping data for the background concentrations are discussed in Section 5.5 and Appendix B.3 in Volume 2.

5.6.6 Another uncertainty is with using historical meteorological data to estimate future concentrations. The key limiting assumption is that conditions in the future will be the same as in the past; however, in reality no two years are the same. In line with best practice, the base year meteorology (as used in the model verification and adjustment process) has been used in future year modelling to allow any adjustments to be applied in future cases.

5.7 Baseline conditions

5.7.1 Information on existing ambient air quality i.e. baseline conditions, and identification of potential air quality constraints to the Scheme, has been determined through reference to the following sources:

- AQMA mapping (Defra, 2018)[50];
- Department for Environment, Food and Rural Affairs (Defra) Pollution Climate Mapping (PCM) model data for 2015[51];
- Highways England project specific nitrogen dioxide (NO_2) diffusion tube survey data;
- Local Authority Local Air Quality Management (LAQM) Reports (Maidstone, 2017, Swale 2017, and Medway, 2017)[52];
- Natural England (NE) MAGIC website (Natural England, 2016)[53] to identify boundaries of designated ecological sites; and
- Ordnance Survey (OS) base mapping to identify locations of sensitive receptors (residential properties, schools, hospitals and elderly care homes).

5.7.2 Figure 5.1 in Volume 3 shows the air quality constraints within the study area.

Pollutants

5.7.3 The air pollutants of concern in the context of the local air quality assessment for the Scheme are NO_2 and PM_{10}, as these pollutants are most likely to be present in ambient air at concentrations close to or above statutory limit values at receptors near to roads. In addition, the ecological assessment considers NO_x and nitrogen deposition. The regional assessment of vehicle emissions associated with the Scheme considers NO_x, CO_2 and PM_{10}. $PM_{2.5}$ is not required to be assessed as discussed in Appendix B.1 in Volume 2, however information on measured concentrations is provided in this section for information purposes. Further information on pollutants is provided below.

Nitrogen dioxide / oxides of nitrogen

5.7.4 NO_2 is a secondary pollutant produced by the oxidation of nitric oxide (NO). NO and NO_2 are collectively termed NO_x. About a quarter of the UK NO_x emissions are from road transport[54]. The majority of NO_x emitted from vehicles is in the form of NO, which oxidises rapidly in the presence of ozone (O_3) to form NO_2. In

[50] http://uk-air.defra.gov.uk/aqma/maps
[51] http://uk-air.defra.gov.uk/data/gis-mapping, accessed 2018
[52] Maidstone Borough Council's 2018 Air Quality Annual Status Report, Medway Council's 2018 Air Quality Annual Status Report, and Swale Borough Council's 2018 Air Quality Annual Status Report, all obtained from http://www.kentair.org.uk/home/text/454
[53] http://magic.defra.gov.uk/
[54] http://naei.beis.gov.uk/data/

high concentrations, NO_2 can affect the respiratory system and can also enhance the response to allergens in sensitive individuals. Additionally, there is increasing awareness of an association between long-term average concentrations (chronic exposure) of NO_2 and mortality. NO does not have any observable effect on human health at the range of concentrations found in ambient air. Elevated concentrations of NO_x can have an adverse effect on vegetation, including leaf or needle damage and reduced growth. Deposition of pollutants derived from oxides of nitrogen emission contribute to acidification and/or eutrophication of sensitive habitats.

Particulate matter

5.7.5 The principal sources of 'primary' polluting particles are combustion processes, which include traffic and industry. Road transport produces around an eighth of primary PM_{10} emissions in the UK[55], of which the majority of emissions are from diesel engines. Finer fractions of particulate matter are associated with a range of symptoms of ill health including effects on the respiratory and cardiovascular systems, on asthma and on mortality.

Carbon dioxide

5.7.6 Carbon dioxide (CO_2) is a greenhouse gas and is used as an indicator of the wider scale, non-local effects of transport schemes. Exposure to CO_2 does not affect human health or ecology at ambient levels so is not significant as a local air pollutant but is important for its national and international role in climate change.

Other pollutants

5.7.7 National assessments have demonstrated that there is no risk of exceedance of the air quality objectives set for 1,3-butadiene, benzene, carbon monoxide, lead or sulphur dioxide due to emissions from traffic anywhere in the UK. These pollutants are therefore not considered further as there is not considered to be a potential for significant effects associated with these pollutants.

5.7.8 In addition to these air pollutants, dust may be generated during the construction phase in areas adjacent to the Scheme and associated works areas. Dust per se is not considered as a local air pollutant but may cause a perceived loss of amenity and can give rise to soiling (dust deposition).

AQMAs

5.7.9 The Scheme is located within the administrative boundaries of Maidstone Borough Council and Swale Borough Council and the air quality study area extends into the local authority area of Medway Council. Although the Scheme itself is not located within an Air Quality Management Area (AQMA), all three local authorities have declared AQMAs within their boroughs as part of their duties under the Local Air Quality Management regime.

5.7.10 Maidstone Borough Council revoked the previous AQMA designation covering the entire Maidstone conurbation and declared a new Maidstone Borough AQMA in May 2018. The new AQMA follows the carriageways of the main roads

[55] http://naei.beis.gov.uk/data/

passing through the borough. The air quality study area extends into this AQMA along the A249 north of the M20.

5.7.11 Swale Borough Council has declared five AQMAs, all of which have been declared for exceeding annual mean NO_2 AQS objectives. None of the AQMAs are included in the air quality study area.

5.7.12 Medway Council has declared four AQMAs, all of which have been declared for exceeding annual mean NO_2 AQS objectives. None of the AQMAs are included in the air quality study area.

5.7.13 Details of the AQMA in the air quality study area are provided in Table 5.5 below.

Table 5.5: Description of AQMAs

Local authority	AQMA name	Air quality criteria exceeded	Description
Maidstone Borough Council	Maidstone Borough AQMA	NO_2 annual mean	The area follows the carriageways of the main roads passing through the Borough, including the M20, A229, A20, A26, A249, and A274

Table Source: Defra's UK AIR website

Defra Pollution Climate Mapping (PCM)

5.7.14 Further information on areas exceeding the EU limit values is available from Defra's PCM model. This model provides estimates of roadside concentrations of pollutants, including annual mean NO_2 and PM_{10}, which are used in annual reporting to the EU regarding compliance with the limit values. The modelled roadside concentration comprises a background component together with a roadside increment.

5.7.15 Not all roads are included within the PCM model. For the reference year 2015, none of the roads within the Defra's PCM model in the vicinity of the study area are shown as exceeding the roadside annual mean NO_2 and PM_{10} limit values of 40 µg/m³.

Air quality monitoring

5.7.16 Air quality monitoring data from continuous monitoring stations (CMS) and passive diffusion tubes in and close to the air quality study area are described below.

Highways England monitoring

5.7.17 Highways England undertook air quality monitoring specifically for the Scheme for two separate periods between December 2015 to May 2016 and between January 2017 to January 2018. The data for the first period between December 2015 to May 2016 were adjusted using a factor of 0.91 derived from Defra's bias adjustment spreadsheet for diffusion tubes prepared by Staffordshire Scientifics Group using 20% triethanolamine (TEA) in water. The second period data between January 2017 to January 2018 were adjusted using a factor of 0.87

derived from Defra's bias adjustment spreadsheet for diffusion tubes prepared by Gradko International Ltd. using 20% triethanolamine (TEA) in water.

5.7.18 The adjusted mean results for 2016 were then annualised, using a factor of 0.96, following analysis of data from three background continuous monitoring stations within 50 miles of the Scheme (Canterbury, Rochester Stoke and Thurrock) in accordance with LAQM(TG(16)). The air quality monitoring data for the period December 2015 to May 2016 are presented in Table 5.6 below, which shows that the annual mean NO_2 AQS objective was exceeded at one site recorded after annualisation and adjustment, at a site adjacent to the A249 south of Junction 5, not representative of exposure.

Table 5.6: Highways England NO_2 diffusion tube monitoring data 2016, µg/m³

Site ID	Highways England site ID	X	Y	2016 unadjusted period mean concentration (µg/m³)	2016 adjusted, annualised concentration (µg/m³)
M2J5_001_2016	M2J5_001	585206	161727	**59.8**	**52.3**
M2J5_002_2016	M2J5_002	585902	162621	33.4	29.2
M2J5_003_2016	M2J5_003	581274	163419	25.9	22.7
M2J5_004_2016	M2J5_004	586086	162142	31.6	27.6
M2J5_005_2016	M2J5_005	587469	161377	22.0	19.2
M2J5_006_2016	M2J5_006	588137	164233	33.6	29.3
M2J5_007_2016	M2J5_007	587967	164216	30.3	26.5
M2J5_008_2016	M2J5_008	587741	161905	23.9	20.8
M2J5_009_2016	M2J5_009	587266	163738	28.2	24.6
M2J5_010_2016	M2J5_010	587775	163468	19.8	17.3
M2J5_011_2016	M2J5_011	588687	162733	22.0	19.2
M2J5_012_2016	M2J5_012	588313	160896	23.7	20.7
M2J5_013_2016	M2J5_013	583119	163599	27.3	23.9
M2J5_014_2016	M2J5_014	579733	163371	30.9	27.0
M2J5_015_2016	M2J5_015	580522	163095	34.9	30.5
M2J5_016_2016	M2J5_016	580022	163054	**41.5**	36.3
M2J5_017abc_2016	M2J5_017abc	585861	164816	32.6	28.5
M2J5_018_2016	M2J5_018	583390	162002	15.3	13.4

Values in **bold** exceed the AQS objective of 40 µg/m³

5.7.19 The air quality monitoring data for the period January 2017 to January 2018 are presented in Table 5.7 below, which shows that only one exceedance of the annual mean NO_2 AQS objective was recorded for the 2017 adjusted data, at the same location as during the 2016 survey.

Table 5.7: Highways England NO_2 diffusion tube monitoring data 2017, µg/m³

Site ID	Highways England site ID	X	Y	2017 unadjusted period mean concentration (µg/m³)	2017 adjusted concentration (µg/m³)
M2J5_001_2017	M2J5_001	585206	161727	**76.3**	**66.4**
M2J5_002_2017	M2J5_002	585902	162621	32.2	28.0
M2J5_003_2017	M2J5_003	581202	163348	28.1	24.5
M2J5_004_2017	M2J5_004	586086	162142	30.4	26.5
M2J5_005_2017	M2J5_005	587471	161377	22.2	19.3
M2J5_006_2017	M2J5_006	588168	164240	35.0	30.4
M2J5_007_2017	M2J5_007	587966	164203	28.7	25.0
M2J5_008_2017	M2J5_008	587741	161905	24.2	21.0
M2J5_009_2017	M2J5_009	587465	163864	26.5	23.0
M2J5_010_2017	M2J5_010	587773	163435	17.8	15.5
M2J5_011_2017	M2J5_011	588685	162736	24.1	21.0
M2J5_012_2017	M2J5_012	588313	160895	26.5	23.0
M2J5_013_2017	M2J5_013	583124	163603	28.3	24.6
M2J5_014_2017	M2J5_014	579728	163364	27.0	23.5
M2J5_015_2017	M2J5_015	580519	163097	34.7	30.2
M2J5_016_2017	M2J5_016	580022	163054	**44.7**	38.9
M2J5_017abc_2017	M2J5_017abc	585841	164820	**42.9**	37.3
M2J5_018_2017	M2J5_018	583390	162002	14.2	12.4
M2J5_020_2017	M2J5_020	585288	161787	39.4	34.3
Values in **bold** exceed the AQS objective of 40 µg/m³					

Local authority monitoring

5.7.20 Maidstone Borough Council operates two CMS sites, one of which is close to the study area, at a rural location near Detling, and another in Maidstone beyond the current extent of the Scheme. Swale Borough Council currently operates three CMS sites, which are all beyond the current extent of the study area. Two of these sites are located on the A2 at Newington and Faversham, with the third on the B2006 at Sittingbourne. Prior to 2017 it operated an additional CMS on the A2 Canterbury Road. Medway Council operates two CMS sites at Chatham and Rochester Stoke, however both are beyond the extent of the study area. The locations of the closest CMS to the study area, CM2 and ZW6, are provided in Figure 5.1 in Volume 3. Table 5.8 provides the annual mean NO_2 concentrations from the CMS sites close to the study area. The results show that NO_2

concentrations did not exceed the annual mean AQS objective from 2013 to 2017 at any of the sites considered.

Table 5.8: Annual mean monitoring results NO_2 (µg/m³), 2013 - 2017

Site name	Local authority	OS grid ref (x, y)	2013	2014	2015	2016	2017
CM2 Maidstone Rural	Maidstone BC	580108, 159703	13.5	12.3	12.6	12.0	13.0
ZW3 Ospringe Roadside (2)	Swale BC	600360, 160869	36.9	34.4	32.6	38.7	No data
ZW6 Newington (3)	Swale BC	585861, 164817	34.8	32.9	29.7	28.1	29.7
ZW7 Canterbury Road	Swale BC	591483, 163472	35.9	29.7	30.7	34.7	-
ZW8 St Paul's Street	Swale BC	590264, 164396	33.6	35.1	37.7	35.1	35.4

Table 5.9: Number of 1-hour mean NO_2 concentrations > 200 µg/m³, 2013 - 2017

Site name	OS grid ref (x, y)	2013	2014	2015	2016	2017
CM2 Maidstone Rural	580108, 159703	0	0	0 (67)	0	0
ZW3 Ospringe Roadside (2)	600360, 160869	0	0 (121)	0	0 (104)	No data
ZW6 Newington (3)	585861, 164817	1	1	0	1	0
ZW7 Canterbury Road	591483, 163472	7 (176)	2 (137)	0 (107)	0 (96)	-
ZW8 St Paul's Street	590264, 164396	0	0	1 (120)	0	1

If the period of valid data is less than 85%, the 99.8th percentile of 1-hour means is provided in brackets.

Values in bold exceed the AQS Objective.

5.7.21 Table 5.9 provides the number of exceedances of the 1-hour mean concentration of 200 µg/m³, of which 18 are permitted, for comparison with the 1-hour AQS objective. The results show that the AQS objective was not exceeded at any of the selected sites between 2013-2017.

5.7.22 Table 5.10 provides the ratified annual mean PM_{10} concentrations from the CMS near to the study area. PM_{10} concentrations were below both the annual mean and daily mean AQS objectives from 2013 to 2017 at both sites.

Table 5.10: Annual mean monitoring results PM_{10} (µg/m³), 2013 - 2017

Site name	OS grid ref (x, y)	2013	2014	2015	2016	2017
CM2 Maidstone Rural	580108, 159703	18.8	25.3	19.4	20.0	13.0
ZW3 Ospringe Roadside (2)	600360, 160869	26.0	18.0	26.0	25.0	23.0

Table 5.11: Number of PM_{10} 24-hour means > 50 µg/m³, 2013 - 2017

Site name	OS grid ref (x, y)	2013	2014	2015	2016	2017
CM2 Maidstone Rural	580108, 159703	1	18	3	4	0
ZW3 Ospringe Roadside (2)	600360, 160869	26	4	15	11	8

5.7.23 Passive monitoring of NO_2 using diffusion tubes has been undertaken by local authorities. Maidstone Borough Council, Swale Borough Council and Medway Council monitoring data within 200 m of the study area from 2013 to 2017 is presented in Table 5.12.

5.7.24 Maidstone Borough Council diffusion tubes within the study area include Maid66 and Maid101. Neither of these have exceeded the annual mean AQS objective during 2013 – 2017. Swale Borough Council has one diffusion tube within the study area. This site on Key Street, Sittingbourne has recorded one exceedance of the annual mean AQS objective in 2017. There are no diffusion tubes in Medway Council within the study area.

Table 5.12: Bias adjusted annual mean NO_2 concentrations (µg/m³)

Site name	OS grid ref (X, Y)	2013	2014	2015	2016	2017
Maid66	579106, 158411	35.4	34.8	29.5	31.0	29.1
Maid101	578049, 157248	-	-	-	33.1	33.1
SW62	588178, 164235	39.9	37.1	37.2	38.3	**40.6**

5.7.25 Neither Maidstone Borough Council, Swale Borough Council, nor Medway Council undertakes monitoring of $PM_{2.5}$. The closest CMS site which measures $PM_{2.5}$ concentrations is located at Chatham Roadside site, approximately 10 km northwest of the Scheme. Annual mean concentrations at this site are provided in Table 5.13 and were below the AQS objective in all years.

Table 5.13: Annual mean $PM_{2.5}$ concentrations (µg/m³), 2013 – 2017

Site name	OS grid ref (x, y)	2013	2014	2015	2016	2017
Chatham Roadside	577437, 166993	13	14	12	-	14
Table Source: DEFRA's website: https://uk-air.defra.gov.uk/data/exceedence?						

Receptors

5.7.26 Receptors that are potentially sensitive to changes in air quality are defined in DMRB HA207/07 as housing, schools, hospitals and designated species or habitats within sites designated for their ecological value, located within 200 m of the ARN.

5.7.27 It is best practice to select for assessment human health receptors which are expected to have the largest changes in pollutant concentrations, as well as those likely to have the highest concentrations. These include those receptors

closest to the roads affected by the Scheme, those that are representative of large numbers of properties, those that house the young, the elderly and other susceptible populations, as well as those near junctions, or locations with queuing traffic. The receptors selected for assessment are provided in Appendix B.6 in Volume 2 and include those near M2 Junction 5 and in the Maidstone AQMA, as well as those near affected roads in the wider network. In addition, receptors within new developments were included within the assessment where possible.

5.7.28 There are only a small number of properties within 200 m of the Scheme. In the wider area however, there are sensitive human health receptors near to the A249 and M2 which could be affected. There are also two statutory ecologically designated sites which could be affected: the Queendown Warren SSSI, and the Wouldham to Detling Escarpment SSSI which forms part of the North Downs Woodland SAC.

5.8 Potential impacts

5.8.1 The Scheme has the potential to affect local air quality, both during construction and once in operation. Any effect during construction would be temporary.

Construction

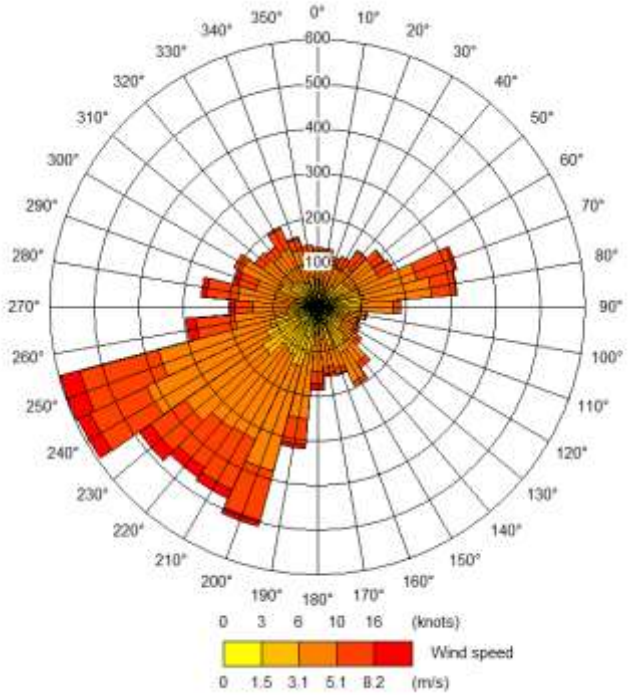
Dust emissions

5.8.2 There is the potential for elevated dust deposition and soiling at properties within 200 m of the Scheme boundary as a consequence of the works, if dust raising activities are not effectively controlled and mitigated. The level and distribution of dust emissions would vary according to the duration and location of activity, weather conditions, and the effectiveness of suppression measures. It is not anticipated that any haul roads will be required.

5.8.3 Receptors within 200 m of the Scheme boundary are shown in Figure 5.2 in Volume 3. The Scheme has the potential for construction dust to affect approximately 80 properties. There are no designated ecological sites within 200 m of the Scheme boundary, although there are parcels of Ancient Woodland which could be affected.

5.8.4 The prevailing winds recorded at Gravesend meteorological station (approximately 28 km northwest of the Scheme) are from the southwest as shown in the windrose in Figure 5.1 below. The highest windspeeds are also recorded from this direction. This suggests that the wind is more likely to transport dust raised on-site towards the northeast of the construction works. Receptors to the northeast include properties in Oad Street and Danaway.

Figure 5.1: Windrose for Gravesend meteorological station (2016)



Construction traffic

5.8.5 An increase in vehicle movements is expected during the construction period, as a result of workers and heavy goods vehicles (HGVs) travelling to and from site. At this stage it is anticipated that the number of HGV deliveries would be 20 to 50 per day, which would be less than the 200 per day criterion for assessment. Any impact on receptors near roads which would be affected by additional traffic movements during the construction period would be expected to be less than the impacts arising during operation.

Operation

5.8.6 Concentrations were estimated for the opening year at 55 selected human health receptors. In addition, four receptors were selected for comparison with the short-term air quality criteria. Both the NO_2 and PM_{10} concentrations were adjusted following verification, details of which are provided in Appendix B.4 in Volume 2. Concentrations of both NO_2 and PM_{10} were compared with relevant UK AQS objectives to determine whether there were likely to be any exceedances.

5.8.7 Modelling has been undertaken using two approaches to determine the future year concentrations: an approach following Defra LAQM.TG(16) and an approach in accordance with IAN 170/12 v3 LTTE. The latter approach is considered the most realistic of the projections for estimating future concentrations, taking into account uncertainty in long-term trends, and has therefore been used as the basis for determining the impact and significance of the changes and for determining compliance with the EU Air Quality Directive. Results for both approaches are presented in Appendix B.7 in Volume 2. The results for changes in annual mean NO_2 concentrations at receptors using the LTTE6 approach are provided in Figure 5.9 in Volume 3.

5.8.8 There are not expected to be any exceedances of the NO_2 annual mean AQS objective at the selected human health receptors in the opening year, both with and without the Scheme.

5.8.9 There are four receptors, R1 (which is within the Maidstone AQMA), R2, R9, and R20, which are expected to have a small increase (0.4 to 2.0 µg/m^3) in NO_2 concentrations with the Scheme. The changes at R1, R2, and R9 are as a result of an increase in traffic flows by approximately 1,300 AADT along this section of the A249. The change at R20 is as a result of an increase in traffic flows by approximately 1,900 AADT along this section of Oad Street.

5.8.10 All other receptors are expected to experience an imperceptible change (less than 0.4 µg/m^3) or small decrease (-0.4 to -2.0 µg/m^3) in NO_2 concentrations with the Scheme. One receptor in Stockbury (R19) is expected to have a large decrease with the Scheme, as a result of the realignment of the A249 away from this receptor.

5.8.11 There is generally expected to be an imperceptible change in concentrations with the Scheme at receptors within AQMAs in Swale Borough Council and Medway Council as these are beyond the study area and so will not be affected by changes in traffic flows associated with the Scheme.

5.8.12 In line with Defra's technical guidance LAQM.TG(16), there are not expected to be any receptors with exceedances of the 1-hour mean AQS objective with the Scheme, given that annual mean NO_2 concentrations at all receptor locations are estimated to be below 60 µg/m^3.

5.8.13 There are not expected to be any exceedances of the PM_{10} annual mean or daily mean AQS objectives. The changes in annual mean concentrations at all receptors are expected to be imperceptible.

Compliance risk assessment

5.8.14 Compliance with the EU Air Quality Directive has been considered using the principles in IAN 175/13 where Defra PCM model links coincide with the modelled area to aid the assessment of significance of effect.

5.8.15 Defra's revised Air Quality Plan was published in 2017, which aids the consideration of compliance. The roads considered in the assessment are within Zone UK0031 (South East). Based on the latest Defra PCM data published (taken from the Defra 2017 plan, with a reference year of 2015) the maximum NO_2 concentration across the roads considered within the study area is projected to be 27.9 µg/m^3 in the opening year (2022) for the M20.

5.8.16 Based on the modelling at human health receptors the maximum increase in annual mean NO_2 concentration is of small magnitude (maximum increase of 1.0 µg/m^3). Consequently, the highest roadside NO_2 annual mean concentration within the air quality study area in 2022 with the Scheme is calculated to be 28.9 µg/m^3. This is below the EU limit value of 40 µg/m^3 and therefore the Scheme is considered to be at low risk of not achieving compliance with the EU Air Quality Directive.

Ecological assessment

5.8.17 The NO_x concentrations estimated at Wouldham to Detling Escarpment (SSSI), overlapping with North Downs Woodlands (SAC), and in Queendown Warren (SSSI) are presented in Appendix B.8 in Volume 2 for the Base Year, 'Do Minimum' and 'Do Something' scenarios. The changes in concentrations at the receptor transect points are shown in Figure 5.9 in Volume 3.

5.8.18 In the base year, the NO_x concentrations are estimated to exceed the critical level for vegetation of 30 µg/m³ up to 136 m into the Wouldham to Detling Escarpment SSSI overlapping with North Downs Woodlands SAC site. In the opening year, the critical level is expected to be exceeded up to 61 m to the north from the edge of the road, both with and without the Scheme.

5.8.19 At the Queendown Warren SSSI site, NO_x concentrations are not estimated to exceed the critical level for vegetation of 30 µg/m³ in either the base year or opening year, both with and without the Scheme.

5.8.20 All transect points at the Wouldham to Detling Escarpment SSSI / North Downs Woodlands SAC were shown to have an increase in annual mean NO_x concentrations with the Scheme, with the greatest increase estimated to be 1.0 µg/m^3 at the closest point on the transect to the A249 (11 m from the road). This is as a result of the increase in traffic flows by approximately 1,300 AADT along this section of the A249.

5.8.21 The estimated nitrogen (N) deposition rates in the Wouldham to Detling Escarpment SSSI overlapping with North Downs Woodlands SAC for the Base, 'Do Minimum' and 'Do Something' scenarios are presented in Appendix B.8 in Volume 2. The results show the total N deposition rates in all scenarios are above/below the UNECE critical load range of 5-15 kg/N/ha/year for coniferous woodland. The greatest increase in total N deposition rates as a result of the Scheme is estimated to be 0.05 kg/N/ha/year, which is a change of less than 1% of the lower range of the critical load. The interpretation of these results is presented in the Biodiversity chapter (Chapter 7).

Regional air quality

5.8.22 Estimated annual emissions of NO_x, PM_{10} and CO_2 are provided in Table 5.14.

5.8.23 Pollutant emissions in the opening year are expected to change with the Scheme by between -0.2% and +0.2%, in line with the increase/decrease in vehicle kilometres travelled of +0.5%. In the 2037 design year, emissions are again expected to increase with the Scheme by between 0.5% and 0.7%, in line with the expected 0.9% increase in vehicle kilometres travelled.

5.8.24 Emissions of NO_x and PM_{10} are expected to decrease overall from the base year by both the 2022 opening year and the 2037 design year despite an increase in total vehicle kilometres travelled, because of improvements in vehicle technology.

5.8.25 Emissions of CO_2 are expected to increase by 0.2% in the opening year compared to 2016 and by 16.1% in the 2037 design year compared to the base year. This is because of an overall increase in vehicle kilometres travelled with the Scheme of 25.5%.

Table 5.14: Regional emissions results

Year	Scenario	NOx (kg/yr)	PM_{10} (kg/yr)	CO2 (t/yr)	Vehicle kms travelled/year
2016	Base	1,577,744	91,849	644,732	2,184,318,380
2022	DM	920,723	79,194	647,026	2,307,182,918
	DS	919,460	79,360	645,876	2,318,612,645
	Change with DS	-1,263	+167	-1,150	+11,429,727
	% Change from DM	-0.1%	+0.2%	-0.2%	+0.5%
	% Change from Base	-41.7%	-13.6%	+0.2%	+6.1%
2037	DM	579,205	88,528	745,291	2,717,245,646
	DS	582,246	89,128	748,832	2,740,967,751
	Change with DS	+3,041	+600	+3,541	+23,722,105
	% Change from DM	+0.5%	+0.7%	+0.5%	+0.9%
	% Change from Base	-63.1%	-3.0%	+16.1%	25.5%

5.9 Design, mitigation and enhancement measures

Construction

5.9.1 Mitigation measures to control dust during construction would be specified within contract documentation and incorporated into an Outline Environmental Management Plan (OEMP). The precise measures would depend on the intended construction methods and the degree of dust generation at each site. Such measures may include but are not necessarily limited to:

- Regular water-spraying and sweeping of unpaved and paved roads to minimise dust and remove mud and debris;
- Using wheel washes, shaker bars or rotating bristles for vehicles leaving the site where appropriate to minimise the amount of mud and debris deposited on the roads;
- Sheeting vehicles carrying dusty materials to prevent materials being blown from the vehicles whilst travelling;
- Enforcing speed limits for vehicles on unmade surfaces to minimise dust entrainment and dispersion;
- Ensuring any temporary site roads are no wider than necessary to minimise their surface area;
- Damping down of surfaces prior to their being worked; and
- Storing dusty materials away from site boundaries and in appropriate containment (e.g. sheeting, sacks, barrels etc.).

5.9.2 If necessary, monitoring parameters and a programme will be established.

Operation

5.9.3 The assessment indicated that there are not expected to be any significant adverse effects with the Scheme for the human health receptors or designated ecological sites during operation. As such, no mitigation measures have been proposed.

5.10 Assessment of effects

Significant effects

Construction

5.10.1 Any adverse air quality effects due to construction will be temporary and can be suitably minimised by the application of standard and appropriate mitigation measures. On this basis, there is unlikely to be a significant effect on air quality due to the construction of the Scheme.

Operation

5.10.2 In accordance with the IAN 174/13, Table 5.15 outlines the evaluation of local air quality significance of the Scheme. None of the receptors are estimated to exceed the annual mean NO_2 air quality objective, hence the Scheme is not expected to have a significant effect on either human health or ecological receptors.

Table 5.15: Overall evaluation of local air quality significance

Key criteria questions	Yes/no
Is there a risk that environmental standards will be breached?	No – no receptors are expected to exceed the annual mean NO_2 AQS objective either with or without the Scheme.
Will there be a large change in environmental conditions?	No – no receptors are expected to have a large increase.
Will the effect continue for a long time?	No – the change is only expected to be small, which is expected to be reversible within approximately 2 to 6 years.
Will many people be affected?	No.
Is there a risk that designated sites, areas, or features will be affected?	Yes – NOx concentrations at the Wouldham to Detling Escarpment SSSI/ North Downs Woodlands SAC are expected to increase with the Scheme due to the increase in traffic flows occurring at the section of the A249 close to the designated ecological site. Changes in nitrogen deposition rates are expected to be less than 0.1 kg/N/ha/year.
Will it be difficult to avoid or reduce or repair or compensate for the effect?	N/A.
On balance is the overall effect significant?	On balance, the overall effect is not expected to be significant for human health receptors. None of the receptors are expected to exceed the annual mean NO_2 AQS objective both with and without the Scheme. In terms of the effect on designated ecological sites, the Scheme is expected to result in an increase

Key criteria questions	Yes/no
	in NOx concentrations at the Wouldham to Detling Escarpment SSSI/ North Downs Woodlands SAC SSSI, although changes in nitrogen deposition rates are expected to be less than 0.1 kg/N/ha/year.

Residual effects

Construction

5.10.3 Any adverse air quality effects due to construction would be temporary and could be suitably minimised by the application of standard and appropriate mitigation measures. On this basis, there is unlikely to be a significant residual effect on air quality due to the construction of the Scheme.

Operation

5.10.4 The results of the assessment have shown that in accordance with IAN 174/13, the Scheme is not expected to have a significant effect on human health or ecological receptors. As no mitigation measures are proposed, the residual effects will be the same as those without mitigation.

5.11 Cumulative effects

5.11.1 Relevant committed developments in the area which could interact with the Scheme are described in Chapter 15 Assessment of Cumulative Effects. During construction, two of these proposals for housing: Land at Woodgate Lane and Builders Yard could potentially affect receptors within the air quality study area for construction, as it is expected that construction will be occurring over the same period.

5.11.2 Specific committed developments were taken into account within the traffic modelling outputs for the air quality assessment, meaning that the air quality assessment during operation already takes into consideration cumulative effects.

5.12 Monitoring

5.12.1 Given that the Scheme is not expected to have any significant adverse effects on air quality, no monitoring is required.

5.13 Summary

5.13.1 An air quality assessment has been undertaken for the Scheme.

5.13.2 A review of baseline conditions has shown that there is one AQMA which could be affected by the Scheme. This AQMA is located in Maidstone at the south of the study area.

5.13.3 Air quality monitoring data shows that there are exceedances of the annual mean AQS objective for NO_2 within the study area at kerbside sites. PM_{10} concentrations are below the objectives. There are no sections of PCM links in the study area which exceed the annual mean NO_2 EU limit value in 2015.

5.13.4 During construction, there is the potential for increased emissions of dust; however, with the application of appropriate mitigation, significant effects at nearby receptors would be unlikely. Additional traffic during construction is considered unlikely to affect air quality.

5.13.5 The assessment showed that no receptors were expected to exceed the annual mean NO_2 AQS objective, with the largest changes being of small magnitude. No receptors were expected to exceed the 1-hour mean AQS objective with the Scheme.

5.13.6 There are not expected to be any exceedances of the annual mean or daily mean PM_{10} AQS objectives.

5.13.7 There are not expected to be any Defra PCM links in the air quality study area that would exceed the annual mean NO_2 EU limit value in 2022 and changes in concentrations would not result in exceedances in 2023 or beyond. There is not expected to be a compliance risk due to the Scheme.

5.13.8 NO_X concentrations were estimated to increase with the Scheme in place compared to the 'Do Minimum' scenario at the Wouldham to Detling Escarpment SSSI / North Downs Woodlands SAC, as a result of an increase in traffic flows on this section of the A249. The change in nitrogen deposition rates was expected to be less than 0.1 kg/N/ha/year.

5.13.9 During operation, the assessment has shown that overall there is not considered to be a significant adverse effect on air quality.

6. Noise and Vibration

6.1 Introduction

6.1.1 This chapter provides the environmental noise and vibration assessment of the Scheme, consisting of information relating to the baseline conditions, identification of sensitive receptors, the expected noise and vibration impacts and the mitigation measures that may be required to avoid significant effects. A commentary describing how noise and vibration impacts from the Scheme affect human health are provided in Chapter 13 Population and Human Health.

6.2 Competent expert evidence

6.2.1 This Noise and Vibration chapter has been undertaken by Michael Kubicki (BEng, AMIOA) and Adam Lawrence (BEng, CEng, FIOA) who are qualified acousticians and hold professional membership with the Institute of Acoustics. They have 5 and 25 years of knowledge and experience, respectively, in noise and vibration and have used their knowledge and professional judgement to undertake this assessment.

6.3 Legislative and policy framework

6.3.1 Current noise policy in England is based on the Noise Policy Statement for England (NPSE)[56], which through the effective management and control of environmental noise within the context of Government policy on sustainable development, aims to:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise other adverse impacts on health and quality of life, where possible; and
- Contribute to the enhancement of the acoustic environment.

6.3.2 These aims are reflected in the National Planning Policy Framework (NPPF)[57] and are further echoed in the National Policy Statement for National Networks (NPSNN)[58] and Planning Practice Guidance concerning noise[59].

6.3.3 The Explanatory Note to the NPSE assists in the definition of significant adverse and adverse with the following concepts:

- NOEL – no observed effect level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise;
- LOAEL – lowest observed adverse effect level. This is the level above which adverse effects on health and quality of life can be detected; and
- SOAEL – significant observed adverse effect level. This is the level above which significant adverse effects on health and quality of life occur.

6.3.4 Government policy and guidance do not state values for the NOEL, LOAEL and

[56] Department for Environment and Rural Affairs (2010), Noise Policy Statement for England. London: Defra
[57] Department for Communities and Local Government (2019). National Planning Policy Framework. London: DCLG
[58] Department for Transport (2014). National Policy Statement for National Networks. London: TSO
[59] Department for Communities and Local Government (2014). Planning Practice Guidance (http://planningguidance.planningportal.gov.uk/)

SOAEL, rather, it considers that they are different for different noise sources, for different receptors and at different times and should be defined on a strategic or project basis taking into account the specific features of that area, source or project. The concepts of NOEL, LOAEL and SOAEL apply to the assessment of noise and vibration in the construction and operational phases of the Scheme.

6.3.5 The legislation and policies considered in undertaking this assessment are detailed in Table 6.1.

Table 6.1: Legislation, regulatory and policy framework for noise and vibration

Scale	Legislation/regulation	Summary of requirements
National	National Planning Policy Framework (NPPF) 2019	Paragraph 180 states that decisions on development should aim to: • ensure that new development is appropriate for its location, taking into account the likely effects (and cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site and wider area impacts that could arise from the development; • mitigate and reduce to a minimum, other adverse impacts resulting from new development, and avoid noise giving rise to significant adverse effects on health and quality of life; and • identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.
	National Networks National Policy Statement (NN NPS)	• To avoid significant adverse impacts on health and quality of life from the new development; • To mitigate and minimise other adverse impacts on health and quality of life from noise from the new development; and • To contribute to improvements to health and quality of life through the effective management and control of noise, where possible.
	The Noise Policy Statement for England (NPSE) (Defra, 2010)	To determine the significant impacts on health and quality of life due to change in noise caused by the Scheme. The policy aims to: • Avoid significant adverse impacts on health and quality of life; • Mitigate and minimise other adverse impact on health and quality of life; and • Contribute to health and quality of life where possible.
	Noise Insulation Regulations (NIR) 1975	• Schemes that make alterations to roads require an assessment under the Noise Insulation Regulations 1975, amended 1988. These regulations give mandatory and discretionary powers to provide noise insulation to residential properties when certain criteria are met.

Scale	Legislation/regulation	Summary of requirements
	Land Compensation Act 1973	• Provides a means by which compensation can be paid to owners of land and property that has experienced a loss in value caused by the use of public works, such as new or improved roads. One of the factors that may be considered to affect the value of land or property is noise and changes in noise are often regarded as contributing to changes in a property's value.
	Control of Pollution Act 1974	• Requirement for the construction contractor to employ Best Practicable Means as noise and vibration control measures. These measures include the usage of screening to reflect sound away from noise sensitive areas and measures for controlling noise or vibration at its source through the usage of quieter equipment and processes and consideration of working hours.

Table Source: Various

6.4 Study area

Construction

6.4.1 With regard to construction phase impacts, the DMRB Volume 11, Section 3, Part 7 HD 213/11 Noise and Vibration[60] (referred to hereafter as DMRB HD213/11) states that: 'the area in which construction is considered to be a nuisance is generally more localised than where the impacts of the road project are likely to be a cause of concern once it has opened to traffic. The impact of construction nuisance in one form or another diminishes rapidly with distance'.

6.4.2 Within BS 5228-12009+A1:2014 it states that 'At distances over 300 m noise predictions have to be treated with caution, especially where soft ground correction factor has been applied, because of the increasing importance of meteorological effects.'

6.4.3 Given that there is a level of uncertainty when predicting construction noise beyond this distance, the study area for the construction noise assessment is 300 m from the anticipated boundary of the physical works associated with the Scheme.

Operation

6.4.4 The study area for the assessment of noise and vibration effects is defined in DMRB 213/11 as 600 m from the carriageway edge of any proposed new routes, existing routes to be bypassed or improved, or any other affected routes within 1 km of the Scheme. An affected route is defined as where it is calculated that there is a possibility of a change of 1dB $L_{A10,18h}$ in the short-term or 3 dB $L_{A10,18h}$ in the long-term (assessed between the opening year and the future year, which are 2022 and 2037 respectively for the Scheme).

6.4.5 The DMRB 213/11 provides the following methodology for identifying the size

[60] The Highways Agency, Transport Scotland, Welsh Government and The Department for Regional Development Northern Ireland (2011). DMRB, Volume 3, Section 3, Part 7: Noise and Vibration. HD 213/11. London: TSO

and extents of the study area:

- Near the Scheme:
  - Identify the start and end points of the physical works associated with the road project;
  - Identify the existing routes that are being bypassed or improved and any proposed new routes between the start and end points (for each option);
  - Define a boundary 1 km from the carriageway edge of each of the options identified above;
  - Define a boundary 600 m from the carriageway edge around each of the options identified above and also 600 m from any other affected routes within the boundary defined above. The total area within these 600 m boundaries is termed the 'calculation area';
- In the wider area:
  - Identify any affected routes beyond the boundary defined near the Scheme; and
  - Define a boundary 50 m from the carriageway edge of routes identified above.
- The total study area is the combination of the area near the Scheme and the area in the wider area.

6.4.6 Based on the above, the detailed noise calculation area (within 600 m of any affected route that is within 1 km of the Scheme) has been determined. The study area is shown in Figure 6.1 and Figure 6.2 in Volume 3.

6.5 Assessment methodology

Construction

Noise

6.5.1 The construction noise calculations and assessments have been undertaken in accordance with guidance in BS 5228 Part 1[61]. The construction activity noise levels in dB LAeq,T were calculated at a reference distance of 10 m from each main construction activity separately, taking into account the list of construction plant expected to be in use and their anticipated usage patterns. The activity noise levels were corrected for distance between the activity and the sensitive receptor, using the equations provided in Annex F of the Standard and based on the predominant intervening ground type.

6.5.2 The effects of construction activity phasing were considered where this information was available, as it is possible that sensitive receptors can be affected by construction noise from multiple locations within the study area. Where this occurs, the predicted construction noise levels at the sensitive receptor from each construction site were combined to determine the total construction noise level.

6.5.3 BS 5228 Part 1 contains example methods for deriving appropriate limit values

[61] British Standards Institution (2014). BS 5228:2009 + A1:2014 Code of practice for noise and vibration control on construction and open sites, Part 1: Noise. London: BSI

that can be used as significance criteria. The Standard explains that the assessor needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect.

6.5.4 Annexes C and D of Part 1 of BS5228 provides generic source noise data for various items of plant used on open sites which can be used in the absence of measured data.

6.5.5 Part 1, Annex E 'Significance of noise effects' of BS5228 presents various methods of determining the significance of noise effects due to construction works. This includes the ABC method detailed in Annex E.3.2, where noise limits are set based on baseline noise levels and which is shown below in Table 6.2.

Table 6.2: Threshold of potential significant construction impacts at dwellings

Assessment category and threshold value period	Threshold value, in decibels (dB) (LAeq,T)		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23.00-07.00)	45	50	55
Evenings (19.00-23.00)	55	60	65
and weekends	55	60	65
Daytime (07.00-19.00) and Saturdays (07.00-13.00)	65	70	75
NOTE 1 - A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level. NOTE 2 - If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. NOTE 3 - Applied to residential receptors only.			
[A] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. [B] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values. [C] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values.			

6.5.6 The ABC method has been used to assess the impacts of the construction activities. Using this method, the impact of an activity has potential to be significant if the noise levels from the construction activities are shown to exceed the relevant threshold value.

6.5.7 The consideration of significance then needs to take the duration of the activity into account along with the characteristics of the existing noise climate.

6.5.8 BS 5228 Part 1 Annex E provides example threshold levels that can be used to determine the eligibility of buildings for noise insulation due to construction noise, as shown in Table 6.3. Noise insulation can be provided if construction noise levels cause "widespread community disturbance or interference with activities or sleep is likely to occur for a significant period of time either continuously or

sporadically", and all reasonable measures to reduce noise have been ineffective.

Table 6.3: Example construction noise threshold levels

Day	Time (hours)	Averaging period (T)	Example noise insulation trigger level, $L_{Aeq,T}$ dB *
Monday to Friday	07:00 - 08:00 08:00 - 18:00 18:00 - 19:00 19:00 - 22:00 22:00 - 07:00	1 hour 10 hours 1 hour 1 hour 1 hour	70 75 70 65 55
Saturday	07:00 - 08:00 08:00 - 13:00 13:00 - 14:00 14:00 - 22:00 22:00 - 07:00	1 hour 5 hours 1 hour 1 hour 1 hour	70 75 70 65 55
Sunday and Public Holidays	07:00 - 22:00 22:00 - 07:00	1 hour 1 hour	65 55
* All noise levels are predicted or measured at a point 1 m in front of the most exposure of any windows and doors in any façade of any eligible dwelling			

Table Source: BS 5228 Part 1, Annex E, Table E.2

6.5.9 In line with common practice on similar infrastructure construction schemes, a "significant time period" for the effects shown in Table 6.3 to be exceeded for is:

- A period of 10 or more days of working in any 15 consecutive days during construction; or
- For a total of 40 days or more in any 6 consecutive months during construction.

6.5.10 The total construction period for the Scheme is expected to be approximately 2 years and the above criteria are appropriate.

6.5.11 Based on the information provided in BS 5228 Part 1, the noise thresholds and averaging periods shown in Table 6.3 are indicative of a SOAEL exceedance occurring at an affected property, where these occur for significant periods of time. Suitable LOAEL threshold levels are construction noise levels that are 10 dB $L_{Aeq,T}$ lower than those shown for the corresponding time periods in Table 6.3, which represents a halving of perceived loudness. Non-residential receptors, such as educational buildings and medical centres, will be subject to individual considerations and have been assessed against the same criteria for times of day and days of the week when they are open.

Vibration

6.5.12 Construction generated vibration has been assessed in accordance with guidance in BS 5228 Part 2[62]. The main construction activities that can result in

[62] British Standards Institution (2014). BS 5228:2009 + A1:2014 Code of practice for noise and vibration control on construction and open sites, Part 2: Vibration. London: BSI

significant levels of vibration are percussive piling, earth compaction works, or other works requiring the use of a vibratory roller. The resulting peak particle velocity (PPV) in mm/s from potential works were calculated at sensitive receptors using the empirical formula in Annex E of BS 5228 Part 2.

6.5.13 Annex B of BS 5228 Part 2 provides guidance on the likely significance of PPV levels in mm/s due to construction works, which is reproduced below.

Table 6.4: Guidance on the effects of PPV vibration levels perceptible to humans

Vibration level *	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower levels, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.
* The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into a recipient. A transfer function (which relates an external level to an internal level) needs to be applied only if external measurements are available. Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6471-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.	

Table Source: BS 5228 Part 2, Source: BS 5228 Part 2, Annex B, Table B.1

6.5.14 Table 6.4 suggests that vibration levels of 0.3 mm/s from construction activities could suitably represent the LOAEL threshold as this is when vibration becomes perceptible. Typically, there are no significant sources of vibration in the general environment to influence people's perceptions and experiences. Therefore, as complaints become more likely, for example when vibration levels are 1 mm/s, this would be an appropriate threshold to use as a SOAEL for construction vibration.

6.5.15 Where high levels of vibration are predicted, the values in Table 6.5 are used to determine the potential for cosmetic damage to buildings.

Table 6.5: Guidance on the effects of vibration levels perceptible to buildings

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
1. Reinforced or framed structures. Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
2. Unreinforced or light framed structures. Residential or light commercial buildings.	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Notes 1. Values referred to are at the base of the building. 2. For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.		

Table Source: BS 5228 Part 2, Annex B, Table B.2

Operation

Noise

Road traffic noise modelling

6.5.16 Noise modelling has been undertaken to predict noise levels with and without the Scheme in its projected opening year (2022) and future assessment year (2037), and to use this information to complete a “detailed” assessment as defined within the DMRB 213/11, which consists of the following elements:

- Prediction of daytime ($L_{A10,18h}$) noise levels in the short-term (Scheme opening) and the long-term (future assessment year) at noise-sensitive receptors in the study area using the Calculation of Road Traffic Noise (CRTN) procedures and the advice in DMRB 11.3.7, Annex 4;
- Prediction of night-time (L_{night}) noise levels in the long-term at noise-sensitive receptors within the study area;
- Assessment of noise levels at traffic links located in the wider area; and
- Assessment of traffic nuisance impacts.

6.5.17 To complete a “detailed” assessment, the following traffic scenarios have been modelled and assessed:

- Do Minimum (without the Scheme) in the opening year (DM 2022);
- Do Something (with the Scheme) in the opening year (DS 2022);
- Do Minimum in the future assessment year (DM 2037); and
- Do Something in the future assessment year (DS 2037).

6.5.18 The noise modelling was undertaken using NoiseMap v5.2.4 software and traffic projections from strategic traffic modelling to permit the degree of accuracy required for a detailed assessment.

6.5.19 The topographical model was built from Scheme drawings and Ordnance Survey Landform 5 m data at locations further away from the Scheme.

6.5.20 Ordnance Survey base mapping and Addressbase data were used to establish the relevant noise sensitive receptors within the appropriate calculation area. This included residential noise sensitive receptors and non-residential noise sensitive receptors, such open leisure spaces and places of worship.

6.5.21 All buildings in the noise model were set to 8 m in height. Receivers were added to each façade of noise sensitive buildings to predict noise levels at heights of 1.5 m and 4 m above ground level, to represent the ground floor and first floor heights of buildings. Further assessment heights were included for tall buildings and the worst-case noise levels predicted for each property have been reported.

Assessment criteria

6.5.22 The assessment criteria for the Scheme takes into account significance of impacts from a policy perspective and from an environmental impact assessment (EIA) perspective. From a policy perspective, it is relevant to consider the number of properties which are above or below the thresholds for significant adverse effects (SOAEL) and adverse effects (LOAEL). From an EIA perspective it is relevant to consider the magnitude of change at receptors, with larger increases in noise being more adverse than smaller increases in noise.

6.5.23 The assessment of the Scheme against policy is undertaken at a scheme-wide level, whereas the assessment of the Scheme against EIA guidelines is undertake on a receptor by receptor basis using the magnitude of change descriptors provided in the DMRB.

6.5.24 The assessment of significance from an EIA perspective is set out in Table 6.6.

Table 6.6: Classification of magnitude of noise impacts

Short-term noise change ($L_{A10,18h}$, dB)	Long-term noise change ($L_{A10,18h}$, dB)	Magnitude of impact (adverse or beneficial)	Potential significance, depending on context
0	0	No change	Not significant
0.1 - 0.9	0.1 - 2.9	Negligible	Low likelihood of significant effect  High likelihood of significant effect
1 - 2.9	3 - 4.9	Minor	
3 - 4.9	5 - 9.9	Moderate	
5+	10+	Major	

Table Source: IEMA (2014) and DMRB Volume 11, Section 3, Part 7, HD 213/11

6.5.25 Table 6.7 shows the thresholds used for LOAEL and the SOAEL based upon guidance for environmental noise assessments and noise thresholds associated impacts to human health, noting that the selected threshold levels have changed slightly since the Environmental Scoping Report (October 2018) was issued.

Table 6.7: Significance threshold levels for road traffic noise

Effect level	Time period	Noise threshold	Relevant guidance
LOAEL	Day	50 dB $L_{Aeq,16h}$ (free-field) 55 dB $L_{A10,18h}$ (1 m from façade)	WHO Community Noise Guidelines (WHO, 1999)
	Night	40 dB L_{night} (free-field)	WHO Night Noise Guidelines for Europe (WHO, 2009)
SOAEL	Day	63 dB $L_{Aeq,16h}$ (free-field) 68 dB $L_{A10,18h}$ (1 m from façade)	Noise Insulation Regulations 1975 (amended 1988)
	Night	55 dB L_{night} (free-field)	WHO Night Noise Guidelines for Europe (WHO, 2009), Transport Analysis Guidance (DfT, 2015)

Table Source: Various

6.5.26 It is noted that new guidance was issued by the World Health Organisation in October 2018 where the threshold noise levels for adverse effects to human health were updated. The threshold levels in this assessment are based on recommendations from older guidance from the World Health Organisation which provide similar thresholds for daytime adverse (LOAEL) noise levels and more stringent criteria for night-time noise levels.

6.5.27 Overall, the assessment of significance takes both policy factors and EIA factors into account and the final decision additionally takes the context of the situation at receptors into account, within the following assessment framework:

- Where changes in noise are shown to be negligible, the impact is considered not to be significant;
- Where noise levels are above SOAEL, impacts may be considered to be significant if changes in noise are perceptible;
- Where noise levels are below LOAEL, impacts are not considered to be significant; and
- Where noise levels are between LOAEL and SOAEL, impacts may be considered to be significant if the changes in noise are moderate or major.

6.5.28 The assessment considers if changes in noise are expected to occur in the short-term or over the long-term.

6.5.29 Where significant effects are identified, it is necessary to consider mitigation to avoid those significant effects occurring.

6.5.30 Additionally, mitigation may be considered to:

- To reduce adverse effects at noise sensitive receptors;
- To mitigate noise levels in areas with existing high noise levels, such as NIAs, which is a stated objective of the overarching RIS programme; and
- To reduce adverse effects at ecologically sensitive areas.

6.5.31 Mitigation in such locations would be considered when it is shown to be cost effective to do so, in line with the context of the Government policy on sustainable development.

6.5.32 Potential locations requiring noise mitigation based on previous assessments were reviewed to allow mitigation measures to be incorporated in the design of the Scheme. Further information regarding the mitigation measures designed into the Scheme are provided in Section 6.9 Design, mitigation and enhancement measures.

6.5.33 Detailed noise modelling has been undertaken based on traffic projections provided by the design team. The detailed noise modelling included noise mitigation measures that will be introduced, retained or replaced by the Scheme.

Vibration

6.5.34 Road traffic can give rise to vibration impacts in two different ways:

- Airborne vibration that normally occurs if the exhaust note of (usually heavy) vehicles coincides with the resonant frequency of a building element, resulting in badly fitting windows or light fittings rattling; or
- Ground-borne vibration that may result from the passage of vehicles over discontinuities in the road surface.

6.5.35 Regarding airborne traffic-induced vibration, the DMRB 213/11 states that impacts should be considered at properties within 40 m of the road and there is a close correlation between road traffic noise levels and annoyance from airborne traffic-induced vibration. This means that if there are no changes to road traffic noise levels at noise sensitive properties then the airborne traffic-induced vibration impact would be unchanged from existing conditions. Furthermore, the DMRB 213/11 states that no traffic-induced vibration impacts should be assumed for noise levels below 58 dB. Therefore, the airborne traffic-induced vibration assessment only considered properties within 40 m of the Scheme where noise levels above 58 dB $L_{A10,18h}$ were predicted.

6.5.36 The DMRB 213/11 provides some guidance on assessment criteria to use for determining vibration impacts from road traffic, applicable to properties within 40 m for the new or altered road. It states that a PPV of 0.3 mm/s measured on the floor of a property in the vertical direction is perceptible and that “if the level of vibration at a receptor is predicted to rise above a level of 0.3 mm/s, or an existing level of 0.3 mm/s is predicted to increase, then this should be classed as an adverse impact from vibration”. The threshold level for perceptibility of vibration stated in the DMRB 213/11 corresponds with that shown in Table 6.3 taken from BS 5228 Part 2. On this basis, a PPV of 0.3 mm/s would be an appropriate threshold to represent the LOAEL.

6.5.37 The DMRB 213/11 also notes: “for vibration from traffic…structure damage can occur when levels are above 10 mm/s…PPVs in the structure of buildings close to heavily trafficked roads rarely exceed 2 mm/s and typically are below 1 mm/s. Normal use of a building such as closing doors, walking on suspended wooden floors and operating domestic appliances can generate similar levels of vibration to those from road traffic noise.” On this basis, a SOAEL threshold of 1 mm/s has been selected to appraise the Scheme, noting that if this value is exceeded,

damage to buildings is unlikely to occur. This value corresponds with the threshold for complaints shown in Table 6.3 taken from BS 5228 Part 2.

6.5.38 Research from Watts (1987)[63] into ground-borne vibration concluded there was a possibility of perceptible ground-borne vibrations generated during the passage of heavy vehicles when there is a road surface irregularity of about 20 mm within about 5 m of a building. This indicates that the condition of the road surface is a significant factor in determining the likelihood of ground-borne vibration impacts, which can be predicted if information about the ground type and the dimensions of the road surface irregularities are known (Watts, 1990)[64]. Road surface irregularities can be removed through remedial works and are most likely to occur if the road is poorly maintained. As the new roads and widened roads introduced by the Scheme would have new road surfaces free from irregularities, ground-borne vibration impacts would not occur. Therefore ground-borne vibration is scoped out of the assessment.

6.6 Assumptions and limitations

Construction

Construction noise

6.6.1 The construction noise assessment assumes free-field conditions to allow comparison with the measured ambient noise levels.

6.6.2 At this stage, a detailed construction programme is not available. From previous experience on similar developments, assumptions have been made for the main noise generating plant and equipment likely to be employed and their corresponding noise levels. Therefore, an indicative assessment has been undertaken. It is assumed that the structures will require piled foundations. These will include installation of bridge abutments and retaining walls.

6.6.3 It is assumed that for each activity, all items of equipment would operate simultaneously, in close proximity and at a location within the proposed A249 alignment close to the receptor. The distance between the assumed plant location and the noise sensitive receptors (NSR) have been estimated from scheme plans.

6.6.4 There will be occasions during the construction programme where the distances will be less than those assumed distances, however this would be for shorter durations of time and in practice not all plant would be operating at that closest location.

6.6.5 Based on similar schemes, it has been assumed that the majority of construction works will be undertaken during the weekday daytime and on Saturday (08:00–13:00), and these have been taken to be the assessment periods.

6.6.6 The assessment considers the amount of time over which each activity takes place. For instance, if a given activity takes place for 6 out of 12 hours, a correction of -3 dB is to be applied to represent the 50% of the period when the activity takes place. Similarly, a correction of -6 dB would be applicable if the activity would take place over 3 hours (25% of the period). For this assessment,

[63] Watts, G.R. (1987). Traffic-induced ground-borne vibrations in dwellings. Research Report 102. Crowthorne: TRRL
[64] Watts, G.R. (1990). Traffic induced vibrations in buildings. Research Report 246. Crowthorne: TRRL

corrections for each item of equipment have been estimated on the following basis:

- 30% - 60% for the main activities likely to stop and start during operation;
- 10% - 20% for minor activities likely to stop and start during operation;
- The assumed plant and equipment for each activity, their corresponding noise levels and percentage on-times is show in the Appendix C.1 in Volume 2. The total noise level for each activity is also shown; and
- The construction assessment assumes that the ground between the construction works and the receptors is soft ground, representative of open grassland or other natural ground types.

6.6.7 The results of the construction noise calculations provide a worst-case assessment of construction noise levels by assuming that all plant for each activity is operating at the closest point to the sensitive receptors. In reality, much of the work for each activity will occur at greater distances as the construction works are not fixed at one location for the duration of the build.

Construction vibration

6.6.8 Vibration levels from piling works may be perceptible at receptors beyond 20 m, and these impacts are assessed using the methods from Annex E of Part 2 of BS5228.

6.6.9 Annex E of Part 2 of BS5228 shows that for piling methods other than percussive piling vibration is unlikely to be perceptible at distances beyond 150 m.

6.6.10 Vibration levels from other construction activities, including demolition, are generally imperceptible at distances greater than around 20 m. Construction vibration assessments have been scoped out for receptors greater than 20 m from these activities.

6.6.11 It is assumed that the structures will require piled foundations, but these are installed using non-percussive techniques.

Operation

Traffic data

6.6.12 The results from the detailed noise modelling are affected by limitations of the input data sources. Crucially, the results from the detailed noise modelling are influenced by the assumptions used to derive traffic flow, speed, and fleet composition data from the strategic traffic model for the Scheme.

6.6.13 The noise predictions were based on the speed bands assigned to each road link rather than speeds generated by the traffic model, in line with IAN 185/15 and current Highways England guidance. The modelling process included obtaining agreement with the traffic modelling team on the speed bands to be used where the speed band changed between traffic scenarios.

6.6.14 The noise model included detailed information about road surfacing in each of the traffic scenarios that were modelled and this was based on the following assumptions and data sources:

- In the Do Minimum scenario in the opening year, the road surface corrections applied to the M2 and A249 were assigned according to the road surfaces identified in the Highways Agency Pavement Management System (HAPMS) for each lane of each carriageway. In accordance with the DMRB 213/11, sections where an existing lower noise road surface was present were assigned a correction of -2.5 dB. From this information, an overall correction was applied to sections of each carriageway[65]. Where HAPMS data was unavailable for the local road network, a bituminous road surface with a texture depth of 1.5 mm was assumed. As the speed on this road for all traffic scenarios was below 75 km/h, a correction of -1dB was applied in line with the CRTN prediction methodology;
- In the Do Something scenario in the opening year, it is assumed that all new and altered roads would be resurfaced with new lower noise surfacing. In accordance with the DMRB 213/11, sections of new lower noise road surfacing were assigned a correction of -3.5 dB. Where a mixture of road surfaces will be present on a given section of carriageway, an overall correction was determined[66]. Road surfacing on all other roads was the same as the Do Minimum scenario; and
- In the Do Minimum and Do Something scenarios in the future assessment year, it is assumed that the A249 and all road links with an existing low noise road surface will be resurfaced with a new low noise road surface during routine maintenance works. In accordance with the DMRB, sections of new lower noise road surfacing were assigned a correction of -3.5 dB.

Geographical data

6.6.15 The heights and widths of the M2/A249 Junction 5 and the access roads were modelled based on the Scheme drawings. The layout of local roads was based on Ordnance Survey data sources.

6.6.16 The resolution of the ground topography data imported into the road traffic noise model influences the results as it affects sound propagation. To minimise uncertainty and to improve the accuracy of the noise model, the ground topography close to the Scheme used very detailed topographical information from the Design Fix 3 drawings and aerial survey data. Further away from the Scheme, where these data sources were unavailable, Ordnance Survey Terrain 5 data was used. This dataset provided equal height ground contours at 5 m height intervals and would therefore not take into account small variations in ground level between each contour interval.

6.6.17 All noise sensitive receptors within the study area have been identified using Ordnance Survey Addressbase and added to the noise model accordingly. Therefore, it is assumed that Addressbase is up to date and has not mislabelled land use categories for addresses. Where there are sensitive receptors that cover a large area, such as designated sites or parks, the level of impact has been assessed based on the variation of and changes to noise levels throughout the site, in line with current Highways England guidance.

[65] Methodology presented at the Institute of Acoustics Sound Transport Modelling conference, Manchester 14/03/2017
[66] Methodology presented at the Institute of Acoustics Sound Transport Modelling conference, Manchester 14/03/2017

Calculation method

6.6.18 The DMRB 213/11 requires an assessment of night-time noise levels (23:00 to 07:00) using the L_{night} noise index. These were calculated by the noise modelling software using "TRL Method 3", which calculates L_{night} based on the predicted daytime $L_{A10,18h}$ noise level. This approach assumes that the diurnal traffic pattern is typical for the roads in the study area.

6.7 Baseline conditions

Noise sensitive receptors

6.7.1 Noise sensitive receptors (NSRs) are defined as places which are potentially sensitive to noise and vibration such as residential dwellings and places where people may reside overnight, such as hotels and hospitals. Other examples include schools, community facilities, places of worship, designated areas, public parks and gardens, and public rights of way.

6.7.2 The land use within 600 m of the M2 Junction 5 is generally agricultural land with residential properties dispersed across the area.

6.7.3 The nearest noise sensitive receptors are located to the south of the M2 motorway, namely Gate House and Whipstakes Farm approximately 170 m south from the A249 Stockbury roundabout. Other residential properties such as The Coach House, Vale Cottages, Vale House, Threeways and Woolpit Ash are up to 400 m from the A249 Stockbury roundabout. North of the M2 Junction 5, there are dwellings on Maidstone Road approximately 400 m from the junction and Milton Bungalow is approximately 80 m from M2.

6.7.4 There are two non-residential noise sensitive buildings within 600 m. To the north of the junction, Sittingbourne and Milton Regis Golf Club, approximately 400 m to the west from A249. To the southwest of the junction, St Mary Magdalene Church is located approximately 240 m west of A249.

6.7.5 The locations of the NSRs are shown on Figure 6.1 in Volume 3.

6.7.6 Several 'Important Areas' for noise (NIAs) have been designated at noise sensitive properties in proximity to the Scheme. NIAs are the locations where the 1% of the population most affected by the highest noise levels from major roads and railways are located according to the strategic noise mapping undertaken by Defra. The NIAs within the study area for the operational phase assessment are shown in the Table 6.8 below.

Table 6.8: Noise Important Areas

Noise Important Areas	Location
4577	A249 north of the roundabout on the border with the top of the study area
4576	A249 north of the roundabout, approximately 250 m from the Scheme
4575	A249 south of the roundabout, approximately 20 m from the Scheme
4574	A249 north of the roundabout, approximately 135 m from the Scheme

Noise Important Areas	Location
12242	A249 north of the roundabout, approximately 600 m from the Scheme
4573	A249 south of the roundabout on the border with the bottom of the study area

6.7.7 The locations of the Important Areas close to the Scheme are shown in Figure 6.1 in Volume 3.

6.7.8 The study area also includes a large designated area for conservation due to its significant landscape value: Area of Outstanding Natural Beauty (AONB), Kent Downs. Bound to the south by M2 corridor, it covers the majority of the noise study area and is further considered quantitatively.

Baseline noise monitoring

6.7.9 During Option Identification Stage, a noise survey was carried out to establish the existing noise climate at the receptors surrounding the junction. Monitoring was undertaken at three locations, referenced as ML1, ML2 and ML3, located 22 m from the M2, 8.5 m from the A249 to the north of M2 and 11 m from the A249 to the south of the M2 respectively.

6.7.10 The monitoring locations are shown in Figure 6.2 in Volume 3.

6.7.11 The results of the baseline monitoring are shown in Table 6.9 below.

Table 6.9: Summary of Option Identification Stage survey results at each monitoring location

Location	Survey dates	Weekday noise levels, dB				Main sources
		$L_{A10,18h}$	$L_{Aeq,\ 3h*}$	$L_{A90,3hr*}$	$L_{max,\ f}$	
ML1	10/03/2016 to 11/03/2016	72.6	69.9	62.2	100.0	Road traffic noise
ML2	10/03/2016	80.7	78.7	71.3	89.9	Road traffic noise
ML3	11/03/2016	77.1	74.2	66.9	97.9	Road traffic noise
*16 hr for long-term measurement, average of short-term samples for short-term measurements.						

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6.8 Potential impacts

Construction

6.8.1 Construction noise

6.8.2 The predicted construction noise levels at a variety of distances up to 300 m from the construction works are presented in Table 6.10 for each of the sub-

activities identified in the construction programme. The significance of these predicted noise levels is discussed in Section 6.10.

Table 6.10: Predicted construction activity noise levels

Construction activity	Predicted construction noise levels at different distances (L_{Aeq}, dB)								
	10m	25m	50m	75m	100m	150m	200m	250m	300m
Site Clearance	83.0	75.1	67.5	63.1	60.0	55.6	52.5	50.1	48.1
Earthworks	82.8	74.9	67.3	62.9	59.8	55.4	52.3	49.9	47.9
Drainage	80.1	72.2	64.6	60.2	57.1	52.7	49.6	47.2	45.2
Road Formation and surfacing	83.5	75.6	68.0	63.6	60.5	56.1	53.0	50.6	48.6
Ducting	71.2	63.3	55.7	51.3	48.2	43.8	40.7	38.3	36.3
Signs and Lighting	80.3	72.4	64.8	60.4	57.3	53.9	49.8	47.4	45.4
Landscaping	81.4	73.5	65.9	61.5	58.4	54.0	50.9	48.5	46.5
Bridge/Retaining Walls	95.0	87.1	79.5	75.1	72.0	67.6	64.5	62.1	60.1

Legend			
	75dB L_{Aeq} or higher		55.0 to 64.9dB L_{Aeq}
	65.0 to 74.9dB L_{Aeq}		45.0 to 54.9dB L_{Aeq}

6.8.3 Table 6.10 above shows that the noise levels generated by most individual activities (except ducting) would exceed the 75 dB L_{Aeq} daytime noise threshold level within 10 m of most construction works. Beyond 100 m of the works the 75 dB L_{Aeq} threshold will not be exceeded. Most properties within the study area are situated more than 100 m from the works therefore the impacts at these properties are likely to fall below of the SOAEL levels.

6.8.4 The highest noise levels predicted are related to bridge and retaining walls construction, with noise levels in excess of 65 dB L_{Aeq} within 150 m of the works. The dominant noise source is associated piling activities and the overall impact will depend on the method used.

6.8.5 The lowest construction noise levels were predicted for ducting, with noise levels exceeding the 65 dB L_{Aeq} threshold within 10 m of the works.

6.8.6 Should works be required at night, all activities would fall below the night-time noise threshold value (55 dB) within 200 m of the construction works, except for bridge and retaining wall works.

6.8.7 Taking into account the various correction factors described above, construction noise levels from each phase of development have been determined at seven assessment locations that are considered representative of all dwellings or other sensitive receptors with a direct line of sight to the construction activities. The construction noise levels have been calculated in dB $L_{Aeq,1hr}$ for each construction phase at representative receptors and are detailed in Table 6.11 below.

Table 6.11: Predicted construction noise levels at representative noise sensitive receptors.

Receptor	Noise level for development phase (dB $L_{Aeq,1\ hr}$)							
	Site clearance	Earthworks	Drainage	Road formation and surfacing	Ducting	Lighting and signage	Landscaping	Bridges
Threeways, Pett Rd, Stockbury, Sittingbourne ME9 7QE	74	74	71	75	62	72	73	61
Vale Cottages, Stockbury Valley, Stockbury Sittingbourne ME9 7QD	79	79	77	80	68	77	78	60
St Mary Magdalene Church, Stockbury, ME9 7RD	49	48	46	49	37	46	47	50
The Studios, Oad Street, Sittingbourne, ME9 8JX	76	75	73	76	64	74	74	51
Whipstakes Farm, Stockbury Valley, Stockbury, Sittingbourne ME9 7QJ	56	56	53	74	45	71	55	62
Sandina, Stockbury Valley, Sittingbourne, Kent, ME9 7QD	77	77	74	77	65	75	75	49
Shortlands, Maidstone Road Borden Sittingbourne, ME9 7Q	68	68	65	68	56	66	66	49

6.8.8 Based on the construction noise levels predicted in Section 6.8, an assessment of the potential construction noise significance has been undertaken.

6.8.9 The predicted construction noise levels shown in Table 6.10 (in Section 6.8) indicate that a potential significant effect could occur at sensitive receptors within 100-150 m of the loudest construction activities, provided that the noise levels exceed the SOAEL for a significant time period. Taking into account the duration of the loudest combinations of activities and whether these would occur for a significant time period, Table 6.12 identifies the sensitive receptors where significant adverse effects and adverse effects are likely.

6.8.10 For each receptor, the measured daytime ambient noise levels have been rounded to the nearest 5 dB to define the appropriate noise category, as described in Table 6.2.

6.8.11 The assessment is based on the comparison of the ambient levels and the predicted construction noise levels, shown in Table 6.12. If a potential significant

effect is indicated, the noise exceedance over the BS5228 category value is also detailed in the table.

Table 6.12: Predicted daytime construction noise impact significance at sample noise sensitive receptors

Receiver name	Ambient value (rounded to nearest 5 dB)	BS5228 category, threshold value	Range of Predicted construction noise levels dB $L_{Aeq,1\ hr}$	Noise exceedance over BS5228 category threshold value dB	Potentially significant effect
Threeways, Pett Rd, Stockbury, Sittingbourne ME9 7QE	65	B	61 - 75	5	Yes
Vale Cottages, Stockbury Valley, Sittingbourne ME9 7QD	75	C	60 - 80	5	Yes
St Mary Magdalene Church, Stockbury, ME9 7RD	60	A	37 - 50	0	No
The Studios, Oad Street, Sittingbourne, ME9 8JX	65	B	51 - 76	6	Yes
Whipstakes Farm, Stockbury Valley, Sittingbourne ME9 7QJ	60	A	45 - 74	9	Yes
Sandina, Stockbury Valley, Sittingbourne, Kent, ME9 7QD	70	C	49 - 77	2	Yes
Shortlands, Maidstone Road Borden Sittingbourne, ME9 7Q	70	C	56 - 68	0	No

6.8.12 The assessment results in Table 6.12 indicate a potential significant effect at five representative receptor locations during the construction period.

6.8.13 Table 6.11 shows that in most cases the highest impact is caused by the road formation and surfacing activities, in one case due to the earthworks and a further one due to the pilling activities. Adverse effects would occur at sensitive receptors within 65 m of road formation and surfacing works and at similar distances for the earthworks activities. For any pilling activities, this extends to

100 m, there are five properties located approximately 80 m away from these activities. These are represented by the 'Vale Cottages' receptor in the Table 6.12 above.

Construction vibration

6.8.14 Vibration levels from typical mobile construction equipment are generally imperceptible at distances greater than around 20 m from the source. There are no noise sensitive receptors within 20 m of the works and this impact has not been considered any further.

Construction traffic impact

6.8.15 There will be a number of heavy goods vehicle (HGV) movements (approximately 20-50 HGV deliveries each day) to/from site during construction of the Scheme for the import and removal of materials and equipment.

6.8.16 As most of the construction activities are associated with and localised along the A249 and considering that construction traffic would access the various works sites from the A249 rather than from local roads, construction vehicles are unlikely to give rise to a perceptible change in traffic noise at the nearest receptors. The access to the New Maidstone link is likely to be from the existing Maidstone Road that is currently an exit route from the Stockbury roundabout. There are no residential receptors near the existing Maidstone road and the M2 would also provide noise masking for any construction traffic.

Operation

Noise

6.8.17 Detailed predictions have been carried out for a total of 120 residential receptors identified within the study area; together with a total of 2 non-residential noise sensitive receptors – St Mary Magdalene church and Sittingbourne & Milton Regis Golf club.

6.8.18 The sections below detail the short-term and long-term impacts of the Scheme. For short-term impacts, a comparison is made between the Do Something and Do Minimum scenarios in 2022, the opening year of the Scheme. For long-term impacts as a result of the Scheme, a comparison is made between the Do Minimum scenario in 2022 and the Do Something scenario in 2037. Long-term impacts without the Scheme have also been considered. The predicted daytime and night-time noise levels and noise nuisance information for a selection of noise sensitive properties is shown in Appendix C.2 and C.3 in Volume 2.

Mitigation inherent in design

6.8.19 The Scheme includes noise mitigation inherent in the design to minimise the potential for adverse effects occurring. These mitigation measures predominantly consist of low noise road surfacing.

6.8.20 There are sections of the A249 within the study area that already have a low noise surfacing installed. By 2022, all these surfaces will have been in place for at least 5 years and are therefore assumed to be performing less effectively than a newer low noise surface.

6.8.21 The noise predictions take into account existing noise mitigation measures and new mitigation measures proposed by the Scheme.

6.8.22 In the opening year scenarios, the unchanged low noise surfaces were modelled with a correction of -2.5 dB, with all altered roads in the 'Do Something' scenario modelled as -3.5 dB; when compared with a standard hot rolled asphalt road. In the design year, the A249 is modelled with a correction of -3.5 dB, as it has been assumed roads would be resurfaced in the future as part of the Highways England road maintenance programme.

6.8.23 Low noise surfacing is assumed only for roads with a speed of over 75 kph for both the 'Do Minimum' and 'Do Something' scenarios.

Changes to daytime road traffic noise levels

6.8.24 Table 6.12 to Table 6.15 show the predicted changes in daytime noise levels for residential and non-residential receptors in the study area. The predicted daytime noise levels throughout the study area are shown in noise change contours provided in Figures 6.3 to 6.5 in Volume 3 to illustrate how road traffic noise levels change in the short-term and the long-term.

Table 6.13: Short-term traffic noise magnitude changes with the Scheme

Impact; change in noise level			Daytime $L_{A10, 18h}$ (0600-0000 hrs)		Noise Important Areas
			Number of dwellings	Number of other sensitive receptors	
Adverse; Increase in noise level, dB	Negligible	0.1-0.9	82	1	4573, 12242, 4576
	Minor	1-2.9	1	0	
	Moderate	3-4.9	0	0	
	Major	>=5	0	0	
No change		0	1	0	
Beneficial; Decrease in noise level, dB	Negligible	0.1-0.9	14	0	
	Minor	1-2.9	12	1	
	Moderate	3-4.9	7	0	4574,4575
	Major	>=5	2	0	

6.8.25 Table 6.13 shows that most properties will be subject to no change or a negligible adverse increase in noise levels in the opening year of the Scheme.

6.8.26 One property will be subject to minor adverse increase in noise level, although the highest expected change is 1.0 dB which is just at the threshold of perceptibility. This receptor is located along Maidstone Road.

6.8.27 The results also show that two properties will be subject to a major decrease in noise level with further seven subjects to moderate decrease in noise level. These properties are located to the south of the Stockbury roundabout, along the A249, close to NIAs 4574 and 4575.

6.8.28 At twelve properties, a minor decrease in noise level is expected.

6.8.29 The predicted noise levels at NIAs generally changed by less than 1 dB $L_{A10,18h}$ in the opening year of the Scheme. There were moderate noise decreases at some properties located within two NIAs. Decreases of 4 dB or more were predicted at properties within NIA 4574 and NIA 4575. Reduction in noise in these locations is related to:

- Change in the road alignment, moving the road away from the area, and
- Provision of lower noise road surfacing on the A249.

6.8.30 The predicted changes in daytime road traffic noise levels in the long-term with and without the Scheme are shown in Table 6.14 and Table 6.15 below, and Figures 6.3 to 6.5 in Volume 3.

Table 6.14: Long-term traffic noise magnitude changes without the Scheme

Impact; change in noise level			Daytime $L_{A10, 18h}$ (0600-0000 hrs)		Noise Important Areas
			Number of dwellings	Number of other sensitive receptors	
Adverse; Increase in noise level, dB	Negligible	0.1 - 2.9	119	2	4573, 4574,4575 12242, 4576
	Minor	3 - 4.9	0	0	
	Moderate	5 - 9.9	0	0	
	Major	>= 10	0	0	
No change		0	0	0	
Beneficial; Decrease in noise level, dB	Negligible	0.1 - 2.9	0	0	
	Minor	3 - 4.9	0	0	
	Moderate	5 - 9.9	0	0	
	Major	>= 10	0	0	

Table 6.15: Long-term traffic noise magnitude changes with the Scheme

Impact; change in noise level			Daytime $L_{A10, 18h}$ (0600-0000 hrs)		Noise Important Areas
			Number of dwellings	Number of other sensitive receptors	
Adverse; Increase in noise level, dB	Negligible	0.1 - 2.9	105	1	4573, 12242, 4576
	Minor	3 - 4.9	0	0	
	Moderate	5 - 9.9	0	0	
	Major	>= 10	0	0	
No change		0	1	0	
	Negligible	0.1 - 2.9	7	1	

Impact; change in noise level			Daytime $L_{A10, 18h}$ (0600-0000 hrs)		Noise Important Areas
			Number of dwellings	Number of other sensitive receptors	
Beneficial; Decrease in noise level, dB	Minor	3 - 4.9	6	0	4574,4575
	Moderate	5 - 9.9	0	0	
	Major	>= 10	0	0	

6.8.31 Table 6.14, Table 6.15 and Figures 6.3 to 6.5 in Volume 3 show that for most receptors, the pattern of long-term changes to road traffic noise levels with and without the Scheme is similar, with most receptors being subject to negligible changes in noise.

6.8.32 With the Scheme, six properties are predicted to experience a beneficial minor decrease in noise levels, with a further seven being subject to a negligible decrease. These are located at Stockbury Valley, ME9 7QD, near the existing Oad Street. The decrease in noise is related to the change in the A249 alignment which effectively moves the road further away from these receptors and due to the provision of the low noise surfacing.

6.8.33 At one property the prediction shows no change in noise level.

6.8.34 No long-term noise increases greater than 1 dB $L_{A10,18h}$ were predicted at any of the NIAs in the study area. Minor noise decreases were predicted at NIA 7574 and NIA 7575 with the Scheme as per Table 6.15. These NIA relate to the same locations as receptor decreases at Stockbury Valley.

'Area of Outstanding Natural Beauty' noise impacts

6.8.35 Part of the Kent Downs Area of Outstanding Natural Beauty (AONB) falls within the noise study area. The total area of the AONB is 880 square km, of which less than 3 square km falls within the noise calculation area. The assessment below considers the changes in noise within the part of the AONB in the noise calculation area, which is significantly less than 1% of the total area of the AONB.

6.8.36 Table 6.16 and Table 6.17 below show the short- and long-term relation of the magnitude of change to the area affected by the change in noise levels within AONB.

Table 6.16: Short-term magnitude change AONB area affected due to the Scheme

Impact; change in noise level			Daytime $L_{A10, 18h}$ (0600-0000 hrs)	
			Approximate area (thousand m^2)	Area (%)
Adverse; Increase in noise level, dB	Negligible	0.1-0.9	503	18%
	Minor	1-2.9	96	3%
	Moderate	3-4.9	25	1%
	Major	5+	13	<1%

Impact; change in noise level			Daytime $L_{A10, 18h}$ (0600-0000 hrs)	
			Approximate area (thousand m^2)	Area (%)
No change		0	219	8%
Beneficial; Decrease in noise level, dB	Negligible	0.1-0.9	1,024	37%
	Minor	1-2.9	775	28%
	Moderate	3-4.9	75	3%
	Major	5+	57	2%

Table 6.17: Long-term magnitude change AONB area affected due to the Scheme

Impact; change in noise level			Daytime $L_{A10, 18h}$ (0600-0000 hrs)	
			Approximate area (thousand m^2)	Area (%)
Adverse; Increase in noise level, dB	Negligible	0.1 - 2.9	1,339	48%
	Minor	3 - 4.9	16	<1%
	Moderate	5 - 9.9	17	<1%
	Major	>= 10	0	0%
No change		0	200	7%
Beneficial; Decrease in noise level, dB	Negligible	0.1 - 2.9	1,128	40%
	Minor	3 - 4.9	56	2%
	Moderate	5 - 9.9	36	1%
	Major	>= 10	8	<1%

6.8.37 In the short-term more than 50% of the section of the AONB within the study area is expected to be subject to decrease in noise level. Around 1% of this area is expected to have major and moderate increase in noise levels, predominantly near to affected roads in the vicinity of the Scheme. Similarly, 3% of the area would be subject to minor increase in noise level.

6.8.38 In the long-term, less than 1% of this area is expected to be subject to either moderate or minor increase in noise level and around 3% would have minor, moderate or major decreases in noise. Almost all of this part of the AONB would be subject to negligible or no change in noise level with the Scheme.

Changes to night-time road traffic noise levels

6.8.39 The change in road traffic noise levels at night throughout the study area has also been considered in the appraisal of the Scheme.

6.8.40 Table 6.18 and Table 6.19 show the change in night-time noise levels in the long-term for properties with predicted noise levels above 55 dB L_{night}, as required by the DMRB 213/11.

Table 6.18: Long-term traffic night-noise magnitude changes without the Scheme

Change in noise level, dB		Number of dwellings	Number of other sensitive receptors
Increase in noise level, L_{night}	0.1 - 2.9	43	0
	3 - 4.9	0	0
	5 - 9.9	0	0
	>= 10	0	0
No change	0	0	0
Decrease in noise level L_{night}	0.1 - 2.9	0	0
	3 - 4.9	0	0
	5 - 9.9	0	0
	>= 10	0	0

Table 6.19: Long-term traffic night-noise magnitude changes with the Scheme

Change in noise level, dB		Number of dwellings	Number of other sensitive receptors
Increase in noise level, L_{night}	0.1 - 2.9	12	0
	3 - 4.9	0	0
	5 - 9.9	0	0
	>= 10	0	0
No change	0	1	0
Decrease in noise level L_{night}	0.1 - 2.9	0	0
	3 - 4.9	0	0
	5 - 9.9	0	0
	>= 10	0	0

6.8.41 Table 6.18 and Table 6.19 show that no noise sensitive receptors where noise levels of 55 dB L_{night} were predicted are also predicted to have a noise increase exceeding 3 dB. The change in night-time noise levels are therefore considered negligible.

Changes to road traffic noise levels in the wider area

6.8.42 To determine the potential effects within the wider area, the Basic Noise Levels (BNLs) were calculated using the methodology in the CRTN for road links outside of the calculation area.

6.8.43 In the short-term and the long-term, the Basic Noise Level calculations indicated that for the majority of roads the change in road traffic noise levels is expected to

be negligible. Table 6.20 and 6.21 below show the Basic Noise Levels of the main traffic links within the study area for the Opening and Design years respectively.

Table 6.20: Basic Noise Levels, opening year

Road	Link ID	Direction	Do Minimum 2022				Do Something 2022			
			Flow	HGV%	Speed	BNL	Flow	HGV%	Speed	BNL
M2 West	82504_81957	WB	36942	9.2%	97	78.7	37,454	9%	97	78.7
M2 West	82420_81959	SB	35446	11%	97	78.8	36065	11%	97	78.8
M2 East	80519_82388	WB	32950	7%	97	77.9	32951	7%	97	77.8
M2 East	82505_80527	SB	28747	11%	97	77.8	28958	10%	97	77.8
A249 North	82990_88797 (DM) 82990_11117 (DS)	WB	29591	9%	97	77.7	17342	9%	97	73.8
A249 North	88796_82974 (DM) 82990_11117 (DS)	SB	28283	10%	63	73.8	29571	10%	97	77.8
A249 South	89478_82941 (DM) 89478_11114 (DS)	WB	22814	9%	97	76.5	22983	8%	97	76.5
A249 South	82942_89480 (DM) 11133_89480 (DS)	SB	24070	7%	97	76.5	25054	7%	97	76.7
Maidstone Road	99986_99990 (DM) 99990_11126 (DS)	NB and SB	2047	6%	97	65.6	2886	4%	97	66.8

Table 6.21: Basic Noise Levels, Design year

Road	Link ID	Direction	Do Minimum 2037				Do Something 2037			
			Flow	HGV%	Speed	BNL	Flow	HGV%	Speed	BNL
M2 West	82504_81957	WB	36942	9.2%	97	78.7	44504	9%	97	79.5
M2 West	82420_81959	SB	40576	11%	97	79.4	41149	11%	97	79.4
M2 East	80519_82388	WB	39668	7%	97	78.7	39644	7%	97	78.7
M2 East	82505_80527	SB	32663	10%	97	78.3	33338	10%	97	78.4
A249 North	82990_88797 (DM) 82990_11117 (DS)	WB	33938	10%	97	78.4	19668	10%	97	74.7
A249 North	88796_82974 (DM) 82990_11117 (DS)	SB	33773	10%	63	74.6	37463	9%	97	78.8
A249 South	89478_82941 (DM) 89478_11114 (DS)	WB	25983	8%	97	77.0	26255	8%	97	77.1
A249 South	82942_89480 (DM) 11133_89480 (DS)	SB	27909	8%	97	77.2	30129	7%	97	77.5
Maidstone Road	99986_99990 (DM) 99990_11126 (DS)	NB and SB	2102	7%	97	65.8	3037	4%	97	67.0

Vibration

6.8.44 The long-term change in airborne vibration nuisance for road traffic as a result of the Scheme is shown in Table 6.22 for properties within 40 m of the roads included in the study area, as required by the DMRB 213/11. The sensitive receptors reported in Table 6.22 are those where road traffic noise levels above 58 dB $L_{A10,18h}$ were predicted during the operational phase of the Scheme.

Table 6.22: Traffic airborne vibration nuisance

Change in nuisance level		Number of dwellings	
		Do Minimum	Do Something
Increase in nuisance level	< 10%	9	4
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0
No change	0%	4	4
Decrease in nuisance level	< 10%	0	5
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0

6.8.45 Table 6.22 shows that the predicted long-term traffic-induced airborne vibration nuisance levels were similar with and without the Scheme. However, fewer properties were predicted an increase in airborne vibration nuisance with the Scheme than without the Scheme. On this basis, it is considered that the Scheme would not adversely affect airborne vibration levels at properties in the study area.

6.8.46 In summary there are no adverse impacts from airborne or ground-borne vibration predicted due to road traffic from the Scheme.

6.9 Design, mitigation and enhancement measures

Construction

6.9.1 To mitigate any potential noise and vibration impacts during the construction phase, the construction contractor should consult with the Environmental Health Departments at the relevant Local Planning Authorities to obtain guidance on their requirements for managing and controlling noise and vibration from construction works.

6.9.2 The Outline Environmental Management Plan (OEMP) will be developed into a Construction Environmental Management Plan (CEMP) and implemented by the contractor and be approved by the Local Authorities prior to the commencement of construction works. The CEMP shall outline the following:

- Environmental management and responsibilities;
- Monitoring and auditing processes;
- Procedures that will be used to complete different construction activities;
- Complaints response procedures; and
- Community and stakeholder liaison processes.

6.9.3 A Traffic Management Plan shall also be provided in the CEMP to manage the routing of construction traffic and road diversions during the construction phase of the Scheme.

6.9.4 The contractor will also have the option to apply for a Section 61 consent under the Control of Pollution Act 1974 for some construction works, particularly if night-time working is proposed. This should be discussed when engaging with the Local Authorities prior to works commencing.

6.9.5 The contractor shall also be encouraged to join (if not already a member) the Considerate Contractors Scheme that is recognised by industry and the Government for encouraging firms to be sensitive to the environment.

6.9.6 Good stakeholder relations are often the most effective way to manage potential noise impacts on-site. Therefore, the contractor shall keep local residents and other affected parties informed of the progress of the works, including when and where the noisiest activities will be taking place and how long they are expected to last. All noise complaints shall be effectively recorded, investigated and addressed.

6.9.7 In addition, the contractor shall use the following good working practices that will minimise impacts to local residents and ecological receptors:

- All vehicles and plant fitted with effective exhaust silencers which should be maintained in good and efficient working order;
- All compressors and generators ‘sound reduced’ models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use;
- All ancillary pneumatic percussive tools should be fitted with mufflers or suppressors as recommended by the manufacturers which should be kept in a good state of repair;
- Machines in intermittent use shut down when not in use or where this is impracticable, throttled down to a minimum;
- The site compound and static machines be sited as far as is practicable from noise sensitive buildings;
- Where practicable, plant with directional noise characteristics orientated to minimise noise at nearby properties;
- Plant certified to meet the current EU legislation and should not be louder than the noise levels provided in Annex C and D of BS 5228-1;
- Where appropriate, temporary noise barriers or other noise containment measures installed to minimise construction noise levels;
- The loading or unloading of vehicles and the movement of equipment or materials undertaken in a manner that minimises noise generation;
- Cleaning of concrete mixers to not be undertaken by hammering the drums; and
- When handling materials, care shown not to drop materials from excessive heights.

6.9.8 In addition to the above good working practices, where piling is required, the piling method should be selected carefully to minimise noise and vibration impacts at receptors. Where practicable, piling methods that result in low levels of vibration, such as rotary bored piling, shall be used. Methods that cause much higher levels of vibration, such as percussive piling, shall be avoided wherever possible. Alternative methods such as vibratory piling, pre-boring prior to piling, or using the Giken method could be used instead of percussive piling.

6.9.9 Even with appropriate mitigation in place, it may not be possible to eliminate all noise impacts. However, best practice, considerate working hours, as well as frequent and open communications with stakeholders will help to reduce the residual effect of construction noise and vibration.

Operation

6.9.10 Following the results of the noise assessment for the Option Identification Stage, the viability of an acoustic noise barrier along the A249 was investigated. The prediction however, showed a decrease in noise from the A249 in that area to below the significance threshold and therefore a noise barrier is considered unnecessary and was excluded from the proposed mitigation design.

6.10 Assessment of effects

Significant effects

Construction noise

6.10.1 The construction noise assessment shows that for the majority of the plant assessed, the daytime construction impacts more than 25 m from the works were between the LOAEL of 65 dB and the SOAEL of 75 dB for the majority of the activities.

6.10.2 Without noise mitigation, significant effects are predicted during construction on areas represented by Threeways, Vale Cottages, The Studios, Whipstakes Farm and Sandina.

6.10.3 With temporary noise barriers installed adjacent to the works, predicted daytime construction noise levels are unlikely to exceed the daytime SOAEL and therefore levels are not predicted to be significant.

6.10.4 Where night-time works are required, impacts can be reduced if works are limited to essential works only. The assessment of significance would depend on how long night-time works would need to take place. Further details of the controls in place to manage noise from the works are provided in Section 6.9 and the OEMP (Appendix A in Volume 2).

6.10.5 Where a significant effect is predicted at a noise sensitive property from a construction activity, the contractor will undertake formal consultation with the local planning authority to obtain approval of the works through a Section 61 agreement.

Construction vibration

6.10.6 Based on the predictions shown in Section 6.8, significant adverse effects from construction vibration are unlikely due to the distance of vibration inducing works.

6.10.7 In addition, standard vibration inducing construction works are not anticipated within 20 m of any noise sensitive receptors. Typically, vibration from standard construction plant is not considered significant more than 20 m from noise sensitive receptors.

6.10.8 With careful planning of site access routes and limiting the use of construction plant within 20 m of any noise sensitive receptor, a significant construction vibration impact from construction plant or access routes is unlikely.

Operation noise

6.10.9 As described in Section 6.5, significant adverse effects may occur if moderate or major adverse changes in noise are shown, or (for those receptors where noise levels are above SOAEL) where noise levels increase by at least 1 dB.

6.10.10 Table 6.23 identifies whether the changes in noise are considered to be significant, taking into account the following factors:

- Comparing short-term and long-term changes in road traffic noise levels;
- Comparing daytime and night-time noise levels with LOAEL and SOAEL;
- The sensitivity and circumstances of the receptor (for example, if it is located within a NIA);
- The proportion of sites affected by noise changes (for example, designated sites, parks and open spaces);
- How the Scheme may affect the acoustic character of the study area;
- The likely perception of changes in noise by local residents, which may be influenced by visibility of the Scheme from their properties and landscaping changes; and
- Whether the effect is adverse or beneficial.

Table 6.23: Significance of road traffic noise in the operational phase

Receptor(s)	DMRB impact magnitude		Conclusion of significance of environmental effect	Justification of significance conclusion
	Opening year (2022)	Future year (2037)		
Maidstone Road, ME9 7QA	Negligible to Minor increase	Negligible	Not significant	Most of the properties in that area are expected to experience negligible increase in noise in both opening and future years. At one property predicted noise levels are expected to increase by up to 1dB in the Opening year only. Changes of this magnitude are not considered significant.
Woodgate Lane, ME9 7QB	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Stockbury Valley, ME9 7QD	Moderate decrease	Minor to moderate decrease	Significant beneficial	Predicted noise levels decrease by more than 4dB at properties closest to A249. At one property road traffic noise levels without the Scheme were above the SOAEL and decreased by more than 1dB with the Scheme in the opening year.
Pett Road, ME9 7QE	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Stockbury Valley, ME9 7QH	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Stockbury Valley, ME9 7QJ	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Stockbury Valley, ME9 7QN	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Church Lane, ME9 7RD	Minor decrease	Negligible	Not significant	Although noise decreases of up to 3dB were predicted, changes of this magnitude are not considered significant.
Pett Road, ME9 7RJ	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Pett Road, ME9 7RL	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Stockbury, ME9 7RN	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Oad Street, ME9 8JX	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Oak Close, ME9 7BF	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Maidstone Road, ME9 7PT	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.

Receptor(s)	DMRB impact magnitude		Conclusion of significance of environmental effect	Justification of significance conclusion
	Opening year (2022)	Future year (2037)		
Maidstone Road, ME9 7PU	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Westfield Gardens, ME9 7PW	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Wormdale Hill, ME9 7PX	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
Maidstone Road, ME9 7PY	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
NIA 4573, 12242, 4576,	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in Section 6.5 were not met.
NIA 4574,4575	Moderate decrease	Minor decrease	Significant beneficial	Predicted noise levels decreased by more than 4dB in the opening year.
Kent Downs AONB	Negligible	Negligible	Not significant	Changes in noise in the long-term affect a very small area of the AONB and these changes in noise are not considered to be significant in the context of the wider area of the AONB which is not affected by the Scheme. The Scheme has limited potential to affect people's use and enjoyment of the designated site, for people using the 1% of the AONB within the study area. Furthermore, the use of the AONB is transitory and the significance criteria are based on changes in noise at dwellings.

6.10.11 Table 6.23 shows that no significant adverse effects are identified. One property is subject to a minor increase in noise in the short-term only, which is not considered to be significant.

6.10.12 Significant beneficial effects would occur at two NIA's and properties associated with Stockbury Valley in the long- and short-term due to the change in the road alignment both horizontally and vertically, which moved the source of noise away from these locations and due to use of noise mitigation measures incorporated into the design, namely low noise road surfacing on all lanes of the A249. No significant effects were predicted at the other NIA's.

Operation vibration

6.10.13 The airborne vibration nuisance assessment provided in Section 6.8 indicated that the Scheme would not adversely affect airborne vibration nuisance levels, and no significant adverse effects are expected during operation.

6.10.14 No significant adverse effects are likely from ground-borne vibration as all new roads will have a smooth road surface and be located at least 5 m from properties.

Residual effects

Construction noise and vibration

6.10.15 With the mitigation measures in place and implementation of best practicable means as mentioned in Section 6.8, any adverse effects arising from the construction phase will be minimised. Further control measures can be incorporated such as noise and vibration monitoring at nearest noise sensitive receptors to monitor the potential for significant environmental effects.

Operation noise

6.10.16 As discussed in Section 6.9 and the significant effects section above, the Scheme is not expected to cause significant adverse effects but does create significant beneficial effects for those properties associated within Stockbury Valley.

6.10.17 No further noise mitigation measures are proposed.

Operation vibration

6.10.18 As no significant effects were shown, there are no residual vibration impacts.

6.11 Cumulative effects

6.11.1 There is potential for cumulative effects to occur during the construction and operational phases of the Scheme due to other developments located near to or within the study area. The cumulative effects arising from these other developments are shown in Table 6.24.

Table 6.24: Cumulative effects

Other Scheme	Cumulative impact on assets affected by Scheme	Additional significant construction effects	Additional significant operation effects
Land at Woodgate Lane	There is potential for a cumulative construction effect as a significant effect was predicted at Shortlands during the construction phase of the Scheme. The proposed development would not affect traffic flows, so no operational phase cumulative effects would occur.	Yes	No
Builders Yard	No cumulative construction effects are expected as the schemes are sufficiently far apart. The proposed development would not affect traffic flows in the study area, so no operational phase cumulative effects would occur.	No	No
Land at Wises Lane	No cumulative construction effects are likely as the schemes are sufficiently far apart. No significant effects are expected in the operational phase due to the Scheme.	No	No
Manor Farm	No cumulative construction effects are likely as the schemes are sufficiently far apart. No significant effects are expected in the operational phase due to the Scheme.	No	No

6.12 Monitoring

Construction

6.12.1 Noise monitoring at sensitive areas is a requirement as part of the CEMP. This may also be a requirement if Section 61 consents are sought from the local authorities in the study area.

6.12.2 Vibration monitoring during piling works will be considered. The predicted vibration levels were not high enough for structural damage to occur but may be perceptible at sensitive receptors, attended vibration monitoring may be appropriate at key locations if it is not possible to use a low vibration piling method for the retaining wall construction.

Operation

6.12.3 During the operational phase, routine maintenance of road surfaces is required to avoid further noise and vibration impacts from surface deflections.

6.13 Summary

6.13.1 The road traffic noise modelling results for the operational phase identified no significant adverse effects.

6.13.2 Potential significant beneficial effects were identified in the short- and long-term at properties associated with Stockbury Valley, immediately to the south of the proposed roundabout and at two NIAs.

6.13.3 There is a potential for cumulative construction effects related to the construction of 11 new buildings at Woodgate Lane as a significant effect was predicted at a nearby receptor during the construction phase of the Scheme. No other cumulative effects are expected.

6.13.4 The proposed development at Woodgate Lane would not affect traffic flows, so no operational phase cumulative effects would occur. No significant adverse effects or perceptible noise increases were predicted at sensitive receptors located in Noise Important Areas.

6.13.5 No significant adverse effects from airborne or ground-borne vibration are expected as a result of the Scheme.

7. Biodiversity

7.1 Introduction

7.1.1 This chapter assesses the effects of the Scheme on biodiversity. It has been prepared in accordance with best practice guidance for ecological impact assessment of road schemes including the Design Manual for Roads and Bridges (DMRB) Volume 10, Section 4, relating to Environmental Design and Management[67]; Volume 11, Section 3, Part 4 relating to Ecology and Nature Conservation[68]; IAN 130/10[69] Ecology and Nature Conservation: Criteria for Impact Assessment; and the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment[70].

7.1.2 Desk study and field survey data were used to inform the detailed assessment of nature conservation receptors that were considered likely to be affected by the Scheme. This chapter provides the ecological baseline, an evaluation of the nature conservation receptors relevant to the Scheme and an assessment of the significant effects on those receptors after mitigation, as a result of the Scheme.

7.2 Competent expert evidence

7.2.1 This Biodiversity chapter has been written by a competent ecological consultant who is a full member of CIEEM and a Chartered Environmentalist with 10 years' experience working in the ecology sector. The chapter has been checked and reviewed by competent ecological consultants who hold memberships and charterships with various relevant professional bodies, as well as meeting Atkins' requirements for quality assurance.

7.2.2 To accompany this chapter, Habitat Regulations Assessment (HRA) has been prepared to assess whether likely significant effects as a result of the Scheme will occur on any European Sites, as required by the Conservation of Habitats and Species Regulations 2017. The assessment is provided in Appendix D.6 in Volume 2 and has been undertaken following guidance in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 4, Part 1 Assessment of Implications (of Highways and/or Road Projects) on European Sites (Including Appropriate Assessment) (HD 44/09)[71].

[67] Highways England (1993) Design Manual for Roads and Bridges, Volume 10, Section 4, Environmental Design and Management
[68] Highways England (1993) Design Manual for Roads and Bridges, Volume 11, Section 3, Part 4 Ecology and Nature Conservation
[69] DMRB IAN 130/10: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian130.pdf.
[70] CIEEM (2018) Guidelines for Ecological Impact assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.
[71] Design Manual for Roads and Bridges, Volume 11, Section 4, Part 1 (HS 44/09), former Highways Agency, February 2009.

7.3 Legislative and policy framework

Table 7.1: Legislation, regulatory and policy framework for biodiversity

Scale	Legislation/ regulation	Summary of requirements
National	National Planning Policy Framework (NPPF) 2019[72]	Chapter 15, paragraph 170 of the NPPF "Conserving and enhancing the natural environment" states that planning policies and decisions should contribute to and enhance the natural and local environment by: • Protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan); • Recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland; • Maintaining the character of the undeveloped coast, while improving public access to it where appropriate; • Minimising impacts on and providing net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures; • Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and • Remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate. Chapter 15, paragraph 177 of the NPPF "The presumption in favour of sustainable development does not apply where the plan or project is likely to have a significant effect on a habitats site (either alone or in combination with other plans or projects), unless an appropriate assessment has concluded that the plan or project will not adversely affect the integrity of the habitats site.
	National Networks National Policy Statement (NN NPS) 2014	Chapter 3, 'Wider government policy on the national networks': • 3.2 The Government recognises that for development of the national road and rail networks to be sustainable these should be designed to minimise social and environmental impacts and improve quality of life. • 3.3 In delivering new schemes, the Government expects applicants to avoid and mitigate environmental and social impacts in line with the principles set out in the NPPF and the Government's planning guidance. Applicants should also provide evidence that they have considered reasonable opportunities to deliver environmental and social benefits as part of schemes. Chapter 5, 'Biodiversity and ecological conservation':

[72] Department for Communities and Local Government (2019). National Planning Policy Framework. London: DCLG

Scale	Legislation/ regulation	Summary of requirements
		• 5.27 The most important sites for biodiversity are those identified through international conventions and European Directives. The Habitats Directive provides statutory protection for European Sites and equivalent policy protection is afforded to Ramsar sites[73] (relevant paragraphs also include 4.22-4.25 relating to Habitat Regulations Assessment). • 5.29 Where a proposed development is likely to have an adverse effect on a Site of Special Scientific Interest (SSSI), development consent should not normally be granted. Where an adverse effect on a site's notified special interest features is likely, an exception should be made only where the benefits of the development at this site clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest, and any broader impacts on the wider network of SSSIs. The Secretary of State should ensure that the applicant's proposals to mitigate the harmful[74] aspects of the development and, where possible, to ensure the conservation and enhancement of the site's biodiversity or geological interest, are acceptable. Where necessary, requirements and/or planning obligations should be used to ensure these proposals are delivered. • 5.31 Sites of regional and local biodiversity (which include Local Nature Reserves, Local Wildlife Sites and Nature Improvement Areas) have a fundamental role to play in meeting overall national biodiversity targets, in contributing to the quality of life and the well-being of the community, and in supporting research and education. The Secretary of State should give due consideration to such regional or local designations. However, given the need for new infrastructure, these designations should not be used in themselves to refuse development consent. • 5.32 Ancient Woodland is a valuable biodiversity resource both for its diversity of species and for its longevity as woodland. Once lost it cannot be recreated. The Secretary of State should not grant consent for any development that would result in the loss or deterioration of irreplaceable habitats including Ancient Woodland and the loss of aged or veteran trees found outside Ancient Woodland, unless the national need for and benefits of the development, in that location, clearly outweigh the loss. Aged or veteran trees found outside Ancient Woodland are also particularly valuable for biodiversity and their loss should be avoided[75]. Where such trees would be affected by development proposals, the applicant should set out proposals for their conservation or, where their loss is unavoidable, the reasons for this. • 5.33 Development proposals potentially provide many opportunities for building in beneficial biodiversity or geological features as part of good design[76]. When considering proposals, the Secretary of State should

[73] Special Areas of Conservation and Special Protection Areas, as well as Sites of Community Importance, cSACs, pSPAs, Ramsars, pRamsars and sites identified, or required, as compensatory measures for adverse effects on any of these European Sites.
[74] In line with the principle above, the term "harm" should be understood to mean significant harm.
[75] This does not prevent the loss of such trees where the decision-maker is satisfied that their loss is unavoidable.
[76] The Natural Environment White Paper 2011 identifies opportunities for transport to contribute to the creation of coherent and resilient ecological networks.

Scale	Legislation/ regulation	Summary of requirements
		consider whether the applicant has maximised such opportunities in and around developments. • 5.35 The Secretary of State should ensure that applicants have taken measures to ensure that statutory protected species[77] and species and habitats identified as being of principle importance for the conservation of biodiversity in England[78] are protected from the adverse effects of development. Where appropriate, requirements or planning obligations may be used in order to deliver this protection. The Secretary of State should refuse consent where harm to the habitats or species and their habitats would result, unless the benefits of the development (including need) clearly outweigh that harm. • 5.36 Applicants should include appropriate mitigation measures as an integral part of their proposed development, including identifying where and how these will be secured. In particular, the applicant should demonstrate that: – During construction, they will seek to ensure that activities will be confined to the minimum areas required for the works; – During construction and operation, best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised (including as a consequence of transport access arrangements); – Habitats will, where practicable, be restored after construction works have finished; – Developments will be designed and landscaped to provide green corridors and minimise habitat fragmentation where reasonable; and – Opportunities will be taken to enhance existing habitats and, where practicable, to create new habitats of value within the site landscaping proposals, for example through techniques such as the 'greening' of existing network crossing points, the use of green bridges and the habitat improvement of the network verge. • 5.37 The Secretary of State should consider what appropriate requirements should be attached to any consent and/or in any planning obligations entered into in order to ensure that mitigation measures are delivered.5.38 The Secretary of State will need to take account of what mitigation measures may have been agreed between the applicant and Natural England, and whether Natural England has granted or refused, or intends to grant or refuse, any relevant licences, including protected species mitigation licences.
	Department for Transport Road Investment Strategy 2015-2020 (RIS)	Section 6 includes aspirations by 2040 to have improved environmental outcomes, including a net gain in biodiversity from the Company's (Highways England) activities.

[77] Certain plant and animal species, including all wild birds, are protected under the Wildlife and Countryside Act 1981. European plant and animal species are protected under the Conservation of Habitats and Species Regulations 2010 (as amended). Some other animals are protected under their own legislation, for example Protection of Badgers Act 1992

[78] Lists of habitats and species of principal importance for the conservation of biological diversity in England published in response to Section 41 of the Natural Environment and Rural Communities Act 2006 are available from the Biodiversity Action Reporting System website.

Scale	Legislation/ regulation	Summary of requirements
		Section 7 one of the key performance indicators is 'delivering better environmental outcomes'. Investments made to achieve ambitions include the setting up of an Environment Fund to improve and halt the loss of local biodiversity. Areas targeted for the Environment Fund: • Increasing the number of SSSIs in good or recovering condition; and • Interventions to support Nature Improvement Areas. One of the Key Performance Indicators (KPI) is Biodiversity: Delivery of improved biodiversity, as set out in the Company's Biodiversity Action Plan.
	Highways England: Strategic Business Plan 2015 to 2020	A commitment to continue to 'manage land immediately surrounding the network to improve biodiversity'. Delivering better environmental outcomes: • KPI: Delivery of improved biodiversity, as set out in the Company's Biodiversity Action Plan. Target: The Company should publish its Biodiversity Action Plan by 30 June 2015 (published), and report annually on how it has delivered against the Plan to reduce net biodiversity loss on an ongoing annual basis.
	Highways England's Biodiversity Plan[79]	Proposes a local approach to improving biodiversity surrounding the road network and encourages management activities to be guided by the principles of Natural England's The Mosaic Approach: Managing Habitats for Species[80], including efforts to target priority habitats and species[81].
	Natural Environment and Rural Communities (NERC) Act[82]	Section 40 of the NERC Act 2006 sets out the duty for public authorities to conserve biodiversity in England. Habitats and species of principal importance for the conservation of biodiversity are identified by the Secretary of State for England, in consultation with Natural England, are referred to in Section 41 of the NERC Act for England. The list, known as the 'England Biodiversity List', of habitats and species can be found on the Natural England web site. The 'England Biodiversity List' is used as a guide for decision makers such as public bodies, including local and regional authorities, in implementing their duty under Section 40 of the NERC Act 2006 to have regard to the conservation of biodiversity in England when carrying out their normal functions.
	Government 25-year Environment Plan[83]	Chapter 1, Section 1, includes aspirations to strengthen the requirement on local authorities to ensure environmental net gains across their areas, enable those authorities to 'develop locally-led strategies to enhance the natural environment, creating greater certainty and consistency and avoiding increased burdens on developers' This is expected to have a net

[79] Highways England (2015) Our plan to protect and increase biodiversity.
[80] http://publications.naturalengland.org.uk/publication/6415972705501184
[81] Habitats and species of principal importance for the conservation of biodiversity as identified by the Secretary of State for England, in consultation with Natural England, are referred to in Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 for England.
[82] Habitats and species of principal importance for the conservation of biodiversity as identified by the Secretary of State for England, in consultation with Natural England, are referred to in Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 for England.
[83] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf

Scale	Legislation/ regulation	Summary of requirements
		positive impact on overall development. Immediate ambitions include: • Working in partnership with other Government bodies, local planning authorities and developers to mainstream the use of existing biodiversity net gain approaches; • Updating the tools that underpin biodiversity net gain approaches and reduce process costs on developers; and • Further streamlining of protected species licencing. Future ambitions include expanding the net gain approaches used for biodiversity to include wider natural capital benefits, such as flood protection, recreation and improved water and air quality. With a view to enabling local planning authorities to target environmental enhancements that are needed most in their areas and give flexibility to developers in providing them. Chapter 1, Section 5, "Reducing risks from flooding and coastal erosion" states that the Environment Agency will use its role in statutory planning consultations to seek to make sure that new developments are flood resilient and do not increase flood risk, and that the relevant protections in the National Planning Policy Framework will be strengthened. Chapter 2, "Recovering nature and enhancing the beauty of landscapes" set out the role of National Parks as planning authorities, and their role in shaping the way development is used to contribute to their social, economic and environmental enhancement. It states that 'While development is not prohibited in National Parks or AONBs, major development should take place only in exceptional circumstances.' Chapter 2, Section 3.i "Creating more green infrastructure" states that a national framework for green infrastructure standards will be created to: • Ensure that new developments include accessible green spaces; and • Ensure any area with little or no green space can be improved for the benefit of the community.
Local	Kent's Biodiversity Action Plan[84] (BAP)	Provides action plans for the conservation, enhancement and restoration of priority habitats and species in the county.
	Maidstone Borough Local Plan 2017 (Policy DM3: Natural Environment)	Developers will ensure that new development protects and enhances the natural environment by incorporating measures, where appropriate. Development proposals are expected to appraise the value of the borough's natural environment. Account should be taken of the Landscape Character Guidelines SPD, the Green and Blue Infrastructure Strategy and the Kent Downs AONB Management Plan.
	Maidstone Landscape Character Guidelines SPD	Gives advice on landscape schemes and plant species in an area. These include landscape character types chalk scarp, dry valleys and downs and gault clay vale.
	Maidstone Green and Blue	A network of natural components of open space and water which lie within and between the borough's towns and villages which provide multiple social, economic and environmental benefits.

[84] http://www.kentbap.org.uk/about/

Scale	Legislation/ regulation	Summary of requirements
	Infrastructure (GBI) Strategy	The strategy looks to encourage the creation of links and stepping stones to help in the movement of wildlife and people across the built up urban area.
	Kent Downs AONB Management Plan 2014 – 2019, April 2014	The management plan aims to develop, coordinate and promote policies and new opportunities for the management, conservation and enhancement of the AONB. AONB Management Plan priorities are reflected in policies within each Local Plan and in development management decisions. The National Planning Policy Framework (NPPF) states that LPAs should set criteria-based policies against which proposals for any development affecting landscape will be judged, reflecting the hierarchy of designated sites, so that protection is proportionate to their status. Chapter 5.5 states the aims of the AONB management plan, these include: • BD1: The maintenance and enhancement of existing designated sites and priority habitats, their extension and connection, will be pursued through sensitive management, fragmentation reduction and restoration. Creation of new habitats and habitat corridors will be pursued, informed by landscape character, through collaboration to establish functional ecological networks and high quality green infrastructure; • BD2: Local, regional and national biodiversity targets and spatial priorities for habitats and species distinctive to the Kent Downs will be supported; a Kent Downs AONB response to Biodiversity 2020 targets will be pursued; • BD3: Targeting of advice, grants and planning agreements to reduce fragmentation and enhance the distinctive biodiversity of the Kent Downs will be pursued; and • BD5: The protection, conservation and extension of Kent Downs priority and distinctive habitats and species will be supported through the Local Plan process, development management decisions and the promotion of the Biodiversity Duty of Regard (NERC Act 2006).
	Swale Borough Local Plan 2017 (Policies DM28: Biodiversity and geological conservation and DM29: Woodlands, trees and hedges)	Development proposals will conserve, enhance and extend biodiversity, provide for net gains in biodiversity where possible, minimise any adverse impacts and compensate where impacts cannot be mitigated. The Borough Council will seek to ensure the protection, enhancement and sustainable management of woodlands, orchards trees and hedges.
	Kent Nature Partnership Biodiversity Opportunity Area, Mid Kent Downs Woods and Scarp	This targets (among other objectives) restoration and creation of chalk grassland, enhancement of species-rich neutral grassland and enhancement and reinstatement of woodland management.

Summary of relevant ecological legislation

7.3.1 A summary of UK wildlife legislation relevant to the Scheme is provided in Appendix D in Volume 2.

7.4 Study area

7.4.1 The study area was identified by determining the Ecological Zone of Influence (EZoI) of the Scheme. The EZoI encompasses all the predicted impacts and subsequent effects of the Scheme on nature conservation receptors.

7.4.2 The EZoI includes the Scheme area (i.e. the Scheme boundary, as shown on Figure 1.1 in Volume 3) and extends beyond this area where there are ecological and hydrological links. The EZoI therefore includes land directly adjacent to the Scheme area and nature conservation receptors located further afield due to the potential for indirect effects over a wider area.

7.4.3 Due to the relative importance of some nature conversation receptors and the mobility of some species, the desk study and survey areas have been extended for some receptors[85]. Based on current best practice guidance, this includes the following:

- Two kilometres for statutory designated sites of nature conservation importance, including European designated sites[86] and nationally designated sites, including:
  - Special Areas of Conservation (SACs)[87];
  - Special Protection Areas (SPAs)[88];
  - Ramsar sites[89];
  - Sites of Special Scientific Interest (SSSIs);
  - National Nature Reserves (NNRs); and
  - Local Nature Reserves (LNRs).
- Thirty kilometres for Special Areas of Conservation (SACs) where bats are a qualifying feature[90];
- Two kilometres for non-statutory Local Wildlife Sites (LWSs) and Roadside Nature Reserves (RNRs);
- Five kilometres for bats[91];

[85] http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/11s3p04.pdf. 'The physical scope of an assessment will vary according to the nature of each individual scheme. The area to be considered may need to extend beyond the study area in order to encompass all significant impacts'.
[86] http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section4/hd4409.pdf. 'As a general guide, consideration should be given to any European Sites within 2 km of the route corridor or project boundary' and to 'crossing/adjacent to upstream of, or downstream of, watercourses designated in part or wholly as SACs, cSACs, pSACs, SPAs, pSPAs or Ramsar sites'.
[87] Including candidate and possible SACs (cSACs and pSACs)
[88] Including potential SPAs (pSPAs)
[89] Including proposed Ramsar sites (pRamsars)
[90] http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section4/hd4409.pdf. 'In addition, consideration should be given to any SACs within 30km where bats are noted as one of the qualifying interests'.
[91] http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol10/section4/ha8099.pdf. 'The investigations may need to be extended up to 5 km beyond the corridor for desk top studies'. 'As a minimum, it is recommended that background data searches should be carried out up to 2 km from the proposed development boundary (including all temporary works). However, the data search should be related to the Scheme's ZoI (see Section 2.2.3) and consider the CSZs of species likely to be present (see Section 3.7), and may need to extend up to 10km for larger projects'. (Collins, J (ed) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust. London. Based on these factors and taking account that the Scheme assessment is in consideration

- One kilometre for notable habitats [92] and Ancient Woodland;
- 2 km for notable or legally protected species and invasive plant species;
- Five hundred metres for waterbodies[93]; and
- Fifty metres for veteran trees[94,95].

7.4.4 Additionally, to identify potential effects on biodiversity due to changes in air quality parameters, the desk study has also been extended to consider potential impacts on sensitive habitats (such as European designated sites) that could be impacted by road traffic. Natural England and Highways England are in agreement that only protected sites falling within 200 m of the edge of a road affected by a plan or project need to be considered further for the potential risks associated with road traffic emissions and this has become an accepted standard approach. The Design Manual for Roads and Bridges uses a distance of 200 m as an indicative zone where changes in air quality may affect sensitive ecological receptors[96].

7.4.5 The survey area for nature conservation receptors is described in detail in the Assessment Methodology section.

7.5 Assessment methodology

Desk Study

7.5.1 A desk study was undertaken to gather information on designated sites, habitats and species[97] within the desk study area, from the following sources:

- The Multi-Agency Geographic Information for the Countryside (MAGIC) website98 was used to obtain information on statutory designated sites within 2 km of the Scheme boundary, SACs designated for bats within 30 km of the Scheme boundary and notable habitats and Ancient Woodlands within 1 km of the Scheme boundary;
- Desk study records of non-statutory designated sites and roadside nature reserves within 2 km of the Scheme, notable and legally protected species within 2 km of the Scheme, as well as bats within 5 km of the Scheme were obtained from Kent and Medway Biological Records Centre (KMBRC)[99];
- Records of veteran trees within 50 m of the Scheme have been obtained

of junction improvements in part within the existing highway boundary, and not a large infrastructure scheme, and the CSZ's of species considered likely to be present, an average distance of 5 km was used for the desk study in relation to bats.

[92] This refers to Habitats of Principal Importance, as listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006).

[93] Great crested newts can disperse up to 500 m from a pond. Therefore, water bodies within 500 m of the Scheme boundary have been considered for their great crested newt potential.

[94] Veteran trees are taken to include veteran and ancient trees as per the Woodland Trust definition. Ancient trees are in the final stage of their life, suffering from dieback and decay. Veteran trees are mature, but not yet ancient, and have important features such as hollowing and deadwood. Definitions taken from https://www.woodlandtrust.org.uk/visiting-woods/trees-woods-and-wildlife/woodland-habitats/ancient-trees/ (accessed 24/03/18).

[95] The establishment of 50m extent is defined on a precautionary basis as it encompasses the potential requirement for root protection zones, as defined in BS5837: Trees in Relation to Design, Demolition and Construction, Recommendations (2012). The study area also goes beyond the extent of root protection zone likely for veteran trees to provide a wider context for the Scheme area.

[96] Highways England (2007) Design Manual for Roads and Bridges Volume 11 Section 3 Part 1 Air Quality07

[97] Records are provided from within the last 10 years only.

[98] Magic Website: http://www.magic.gov.uk/. Accessed: January 2019

[99] Data was provided via KMBRC from Kent Ornithological Society for birds, Kent Reptile and Amphibian Group (KRAG) for amphibians and reptiles, and Kent Bat Group for bats.

from the Woodland Trust's website[100]; and

- Ordnance Survey maps and the Where's the Path website[101] were used to identify the presence of waterbodies within 500 m of the extent of the Scheme, in order to establish if great crested newts are potentially present on land within and immediately surrounding the Scheme.

Ecological surveys

7.5.2 An extended Phase 1 Habitat survey was undertaken in relation to each of the Scheme option designs considered as part of the Option Identification Stage in 2015, 2016 and 2017. A verification survey to update the existing extended Phase 1 Habitat survey data and to support this ES was undertaken in November 2018. The surveys broadly followed the Phase 1 Habitat survey methodology as set out in Joint Nature Conservation Committee guidance[102] to record information on the habitats within the survey area and was 'extended' to include a search for evidence of presence and an assessment of the potential for each habitat to support notable and protected species, as recommended by CIEEM[103].

7.5.3 National Vegetation Classification (NVC) surveys of Chestnut Wood and Church Wood were carried out by WSP in May 2016 and June 2017 respectively to identify the NVC community types present and validate the categorisation of the woodland as Ancient Woodland.

7.5.4 Habitat and species specific surveys, and a Habitat Regulations Assessment have been carried out as part of the Option Identification Stage in 2016 and 2017, and also as part of the Preferred Option Stage for this assessment in 2018. The surveys and assessment carried out, and their associated Appendix references, are as follows:

- Dormouse surveys: carried out between May and November (excluding June) 2017 by WSP. Full methodology and results can be found in Appendix D.1 in Volume 2;
- Reptile surveys: carried out between June and September 2017 by WSP. Full methodology and results can be found in Appendix D.2 in Volume 2;
- Breeding bird surveys: carried out in June and July 2018 by Atkins. Full methodology and results can be found in Appendix D.3 in Volume 2;
- Great crested newt habitat suitability index assessment surveys: carried out during May 2016 and July 2017 by WSP and during November 2018 by Atkins. Great crested newt environmental DNA (eDNA) sampling: carried out during June 2018 by Atkins. Full methodology and results can be found in Appendix D.4 in Volume 2;
- Preliminary bat roost assessment of buildings and structures and ground level tree assessments: undertaken during May 2016, and spring and summer 2017 by WSP and August 2018 by Atkins. Full methodology and results can be found in Appendix D.5 in Volume 2;

[100] Woodland Trust website: https://www.woodlandtrust.org.uk/visiting-woods/ancient-tree-hunt/. Accessed: January 2019
[101] Where's The Path website: https://wtp2.appspot.com/wheresthepath.htm. Accessed: November 2018
[102] Joint Nature Conservation Committee (2010). Handbook for Phase 1 habitat survey – a technique for environmental audit.
[103] Chartered Institute of Ecology and Environmental Management (2017). *Guidelines for Preliminary Ecological Assessment.*

- Bat activity surveys: carried out between May and November 2017 by WSP and September and October 2018 by Atkins. Full methodology and results can be found in Appendix D.5 in Volume 2;
- Bat emergence and re-entry surveys of structures and trees: undertaken in August and September 2018 by Atkins. Full methodology and results can be found in Appendix D.5 in Volume 2;
- Habitats Regulations Screening Assessment presented in Appendix D.6 in Volume 2;
- Hedgerow surveys: carried out during November 2018 by Atkins. Full methodology and results can be found in Appendix D.7 in Volume 2; and
- Wintering bird surveys: carried out in winter 2019. These were completed in February 2019. The full methodology and results have been presented in Appendix D.8 in Volume 2. Assessing value (sensitivity) of nature conservation receptors.

7.5.5 Nature conservation features have been valued following the framework provided in IAN 130/10[104] Ecology and Nature Conservation: Criteria for Impact Assessment. This is presented in Table 7.2 below.

7.5.6 The evaluation is based on the information available from desk study results and the surveys carried out to date and uses professional judgement, as well as accepted criteria[105] (e.g. diversity, rarity and naturalness) for valuing nature conservation features in a geographical context.

Table 7.2: Valuation of nature conservation features

Examples of resource valuation based on geographical context
International or European value
Natura 2000 sites including: Sites of Community Importance (SCIs); Special Protection Areas (SPAs); potential SPAs (pSPAs); Special Areas of Conservation (SACs); candidate or possible SACs (cSACs or pSACs[106]); and Wetlands of International Importance (Ramsar sites). Biogenetic Reserves, World Heritage Sites and Biosphere Reserves. Areas which meet the published selection criteria for those sites listed above but are not themselves designated as such[107]. Resident, or regularly occurring, populations of species which may be considered at International or European level[108] where: • The loss of these populations would adversely affect the conservation status or distribution of the species at this geographic scale; • The population forms a critical part[109] of a wider population at this scale; or • The species is at a critical phase[110] of its life cycle at this scale.

[104] DMRB IAN 130/10: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian130.pdf.
[105] Set out in Ratcliffe (1977) A Nature Conservation Review. Cambridge University Press.
[106] pSACs are sites which have been formally advised to the UK government but have not yet been submitted to the European Commission. These sites should be valued at European level on the basis that they meet the relevant selection criteria for a SAC but are not yet designated as such.
[107] Valuation to be made in consultation with Statutory Environmental Body (SEB).
[108] Valuation to be made in consultation with SEB. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC.
[109] Valuation to be made in consultation with SEB. Such population include sub-populations that are essential to maintenance of metapopulation dynamics e.g. critical emigration/immigration links between otherwise discrete populations.
[110] Seasonal activity or behaviour upon which survival or reproduction depends

Examples of resource valuation based on geographical context
UK or National value
Designated sites including: Sites of Special Scientific Interest (SSSIs); Marine Protected Areas (MPAs) including Marine Conservation Zones (MCZs); and National Nature Reserves (NNRs). Areas which meet the published selection criteria e.g. JNCC (1998) for those sites listed above but which are not themselves designated as such[111]. Areas of key/priority habitats identified in the UK Biodiversity Action Plan (BAP); including those published in accordance with Section 41 of the Natural Environment and Rural Communities Act (2006) and those considered to be of principal importance for the conservation of biodiversity[112]. Areas of Ancient Woodland e.g. woodland listed within the Ancient Woodland Inventory[113]. Resident, or regularly occurring, populations of species which may be considered at International, European, UK or National level[114] where: • The loss of these populations would adversely affect the conservation status or distribution of the species at this scale; • The population forms a critical part[115] of a wider population at this scale, or • The species is at a critical phase[116] of its life-cycle at this scale.
Regional value
Areas of key/priority habitats identified in the Regional BAP (where available); areas of key/priority habitat identified as being of Regional vale in the appropriate Natural Area Profile (or equivalent); areas that have been identified by regional plans or strategies as areas for restoration or re-creation of priority habitats (for example South West Nature Map); and areas of key/priority habitat listed within the Highways Agency's BAP. Resident, or regularly occurring, populations of species which may be considered at an International, European, UK or National level[117] [118] and key/priority species listed within the HABAP where: • The loss of these populations would adversely affect the conservation status or distribution of the species at this scale; • The population forms a critical part[119] of a wider population; or • The species is at a critical phase[120] of its life cycle.
County or Unitary Authority area value

[111] Valuation to be made in consultation with SEB.
[112] Valuation to be made in consultation with SEB as such listings do not in themselves indicate intrinsic value, but instead indicate a conservation priority.
[113] Valuation to be made in consultation with SEB, and with use of professional judgement as listing does not in itself indicate intrinsic nature conservation value.
[114] Valuation to be made in consultation with SEB as such listings do not in themselves indicate intrinsic value. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC. Species which may be considered at the UK or National level means: birds, other animals and plants which receive legal protection on the basis of their conservation interest (those listed in the Wildlife and Countryside Act 1981 (as amended), Schedules 1, 5 and 8); species listed for their principle importance for biodiversity (in accordance with the Natural Environment and Rural Communities Act 2006 Section 41 [England]; and priority species listed within the UKBAP or species listed within Red Data Books.
[115] Valuation to be made in consultation with the SEB. Such populations include sub-populations that are essential to the maintenance of metapopulation dynamics e.g. critical emigration/immigration links between otherwise discrete populations.
[116] A seasonal activity or behaviour upon which survival or reproduction depends.
[117] Valuation to be made in consultation with the SEB. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC.
[118] Valuation to be made in consultation with the SEB as such listings do not in themselves indicate intrinsic value. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC. Species which may be considered at the UK or National level means: birds, other animals and plants which receive legal protection on the basis of their conservation interest (those listed in the Wildlife and Countryside Act 1981 (as amended), Schedules 1, 5 and 8); species listed for their principle importance for biodiversity (in accordance with the Natural Environment and Rural Communities Act 2006 Section 41 [England]; and priority species listed within the UKBAP or species listed within Red Data Books.
[119] Valuation to be made in consultation with the SEB. Such populations include sub-populations that are essential to the maintenance of metapopulation dynamics e.g. critical emigration/immigration links between otherwise discrete populations.
[120] A seasonal activity or behaviour upon which survival or reproduction depends.

Examples of resource valuation based on geographical context
Designated sites including: Sites of Nature Conservation Interest (SNCIs); County Wildlife Sites (CWSs); and Local Nature Reserves (LNRs) designated in the county or unitary authority area context[121].
Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such[122].
Areas of key/priority habitats identified in the Local BAP; and areas of habitat identified in the appropriate Natural Area Profile (or equivalent).
Resident, or regularly occurring, populations of species which may be considered at an International, European, UK or National level[123] [124]where: • The loss of these populations would adversely affect the conservation status or distribution of the species across the County or Unitary Authority Area; • The population forms a critical part[125] of a wider population; or • The species is at a critical phase[126] of its life cycle.
Local value
Designated sites including Local Nature Reserves (LNRs) designated in the local context[127].
Trees that are protected by Tree Preservation Orders (TPOs).
Areas of habitat; or populations/communities of species considered to appreciably enrich the habitat resource within the local context (such as veteran trees), including features of value for migration, dispersal or genetic exchange.

Table Source: A direct extract from IAN 130/10; Table 1[128]

7.5.7 As stated in Table 7.2 above, a habitat published under Section 41 of the Natural Environment and Rural Communities Act (2006) (i.e. a Habitat of Principal Importance (HPI)) indicates a conservation priority, not necessarily intrinsic value. HPIs present within and in proximity to the Scheme area are valued based on ecological survey data, their abundance and distribution and inclusion in the Kent BAP[129], which prioritises the conservation of these habitats at a local level.

7.5.8 The nature conservation importance of sites within the Scheme area in terms of their value for terrestrial invertebrates has also been considered with reference to good practice guidance[130].

Impact assessment

7.5.9 This assessment is based on guidance from Design Manual for Roads and Bridges (DMRB) Volume 11: Environmental Assessment, IAN 130/10 and takes

[121] Valuation to be made in consultation with county ecologist or equivalent, with reference made to the criteria for designation.
[122] Valuation to be made in consultation with county ecologist or equivalent.
[123] Valuation to be made in consultation with the SEB. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC.
[124] 95 Valuation to be made in consultation with the SEB as such listings do not in themselves indicate intrinsic value. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC. Species which may be considered at the UK or National level means: birds, other animals and plants which receive legal protection on the basis of their conservation interest (those listed in the Wildlife and Countryside Act 1981 (as amended), Schedules 1, 5 and 8); species listed for their principle importance for biodiversity (in accordance with the Natural Environment and Rural Communities Act 2006 Section 41 [England]; and priority species listed within the UKBAP or species listed within Red Data Books.
[125] Valuation to be made in consultation with the SEB. Such populations include sub-populations that are essential to the maintenance of metapopulation dynamics e.g. critical emigration/immigration links between otherwise discrete populations.
[126] A seasonal activity or behaviour upon which survival or reproduction depends.
[127] Valuation to be made in consultation with county ecologist or equivalent, with reference made to the criteria for designation.
[128] DMRB IAN 130/10: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian130.pdf.
[129] Kent Biodiversity Action Plan (BAP): http://www.kentbap.org.uk/habitats-and-species/priority-habitats/.
[130] Plant, C. (2009) Invertebrates and Ecological Assessment. Available at: http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/SoSM/Colin_Plant_-_Invertebrates.pdf.

account of the CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland[131].

7.5.10 The assessment of the potential effects of the Scheme considers both on-site effects and those that may occur to adjacent and more distant nature conservation receptors. Impacts on nature conservation receptors have been characterised, including consideration of whether they are positive or negative, the probability, complexity, extent, size, reversibility, duration, timing and frequency of the impacts. Impacts can be permanent or temporary and can include:

- Direct loss of habitats (including temporary loss);
- Fragmentation and isolation of habitats;
- Disturbance to species from noise, light or other visual stimuli;
- Changes to key habitat features;
- Changes to the local hydrology, water quality and/or air quality; and
- Direct mortality or injury to wildlife through construction activities and/or operation.

7.5.11 Characteristics of ecological impacts are considered, including their impact magnitude (based on criteria outlined in Table 2.2 of the Design Manual for Roads and Bridges (DMRB) Volume 11: Environmental Assessment Section 2 Part 5[132]) to determine the significance of effect on each receptor.

7.5.12 Effects are unlikely to be significant where receptors of low value (i.e. of value within the Scheme area only) or sensitivity are subject to small or short-term impacts. However, where there are several small-scale effects that are not significant alone, the assessor may determine that, cumulatively, these may result in an overall significant effect. Significant effects are described as either negative or positive.

7.5.13 For designated sites, effects are considered significant when a project and associated activities is likely to either undermine or support the conservation objectives or condition of the site(s) and its features of interest.

7.5.14 When determining the significance of an effect, consideration is given to whether:

- Any processes or key characteristics will be removed or changed;
- There will be an effect on the nature, extent, structure and function of component habitats; and/or
- There is an effect on the average population size and viability of component species.

7.5.15 Functions and processes acting outside the formal boundary of a designated site have also been considered, particularly where a site falls within a wider ecosystem e.g. wetland sites.

[131] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.
[132] DMRB HA 205/08: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section2/ha20508.pdf.

7.5.16 Some habitats/ecosystems can tolerate a degree of minor change, such as localised or temporary disturbance or changes in physical conditions, without such changes harming their function or value. Ecological effects have considered information available about the capacity of ecosystems to accommodate change.

7.5.17 The conservation status of undesignated habitats and species within a defined geographical area has been used to determine whether the effects of the proposals are likely to be significant:

- For habitats, conservation status is determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area; and
- For species, conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area.

7.5.18 The principles of the mitigation hierarchy have been applied when considering impacts and subsequent effects on nature conservation receptors within the EZoI. The principles state that in order of preference, impacts on biodiversity should be avoided, reduced, then mitigated. If there are significant residual adverse effects that cannot be mitigated, then compensation will be required. Enhancement measures are also identified to provide benefits for biodiversity above the requirements for avoidance, mitigation or compensation. Measures taken during the preliminary design to avoid and reduce potential impacts/effects are described in Section 7.9.2.

7.5.19 Avoidance and mitigation measures have been incorporated into the Scheme design according to the principles of the mitigation hierarchy and are considered in the assessment of the significance of effects. These measures include those required to achieve the minimum standard of established good practice, together with additional measures to further reduce any negative impacts of the Scheme. The avoidance and mitigation measures include those required to reduce or avoid the risk of committing a legal offence and those that support the consenting process.

7.5.20 Taking mitigation into account, the significance of residual effects on nature conservation receptors has been identified using professional judgement. The significance of residual effects is defined in Table 7.3 below, which is a direct extract from IAN 130/10.

Table 7.3: Significance of residual effects on nature conservation receptors

Significance category	Typical descriptors of effect
Very large	An impact on one or more receptor(s) of International, European, UK or National Value. NOTE: only adverse effects are normally assigned this level of significance. They should be considered to represent key factors in the decision-making process.
Large	An impact on one or more receptor(s) of Regional Value. NOTE: these effects are considered to be very important considerations and are likely to be material in the decision-making process.

Significance category	Typical descriptors of effect
Moderate	An impact on one or more receptor(s) of County or Unitary Authority Area Value. NOTE: these effects may be important but are not likely to be key decision-making factors.
Slight	An impact on one or more receptor(s) of Local Value. NOTE: these effects are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project.
Neutral	No significant impacts on key nature conservation receptors. NOTE: absence of effects, or those that are beneath levels of perception.

Table Source: A direct extract from IAN 130/10; Table 3[133]

Consultation

7.5.21 The following organisations and key stakeholders have been consulted with regards to biodiversity:

- Natural England (option selection and design, survey scope and methodologies, proposed mitigation and compensation);
- Kent Wildlife Trust (option selection and design, potential mitigation and compensation features); and
- Kent County Council (option selection and design, survey scope and methodologies and potential mitigation and compensation).

7.5.22 Consultation with Natural England was carried out throughout the preliminary design process and included the valuation of nature conservation receptors relevant to the Scheme, mitigation and compensation measures, and the assessment of significant effects. Natural England were also consulted on the potential impacts, effects, mitigation, compensation and enhancement measures in relation to bats via a separate Discretionary Advice Service (DAS) agreement. Through the DAS process, Natural England confirmed that the survey approach and assessment with regard to bats is sufficient. Natural England's consultation response during the DAS process also included comments on the assessment, including the impacts, mitigation and compensation measures proposed for protected species and notable habitats. Natural England raised no objections with regard to the assessment or its conclusions for protected species or habitats. All comments received from Natural England during the consultation process have been incorporated into this assessment. Enhancement measures were suggested but are not within the Scheme as currently designed and assessed.

7.6 Assumptions and limitations

7.6.1 Ecological surveys are limited by factors which affect the presence of plants and animals such as the time of year, migration patterns and behaviour. The level of survey effort applied to the Scheme to date has enabled sufficient information to be obtained on which to assess the potential impacts and subsequent effects of

[133] DMRB IAN 130/10: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian130.pdf.

the Scheme. However, due to the general mobility of some species and the environmental factors stated above, the surveys of the Scheme footprint may not have produced a complete list of plants and animals, and the absence of evidence of any particular species should not be taken as conclusive proof that the species is not present or that it will not be present in the future. Where the presence/absence of particular species cannot be confirmed, a precautionary approach has been applied to the assessment, which accounts for species that are considered likely to be present as well as those that are recorded as present.

7.6.2 In addition to this chapter of the Environmental Statement, several technical appendices have been prepared for habitats and species specific to the Scheme. Within each of the technical appendices is a summary of survey assumptions and limitations. The details of those are not duplicated here, but none are considered to represent a significant constraint to the preparation of the Biodiversity chapter of the ES.

7.6.3 Previous surveys as part of the Option Appraisal process included extended Phase 1 Habitat surveys of land within and surrounding the Scheme, which were carried out by WSP in 2015, 2016 and 2017. Those surveys were subject to limitations due to the health and safety implications of accessing busy highway carriageways (M2 and A249). A further Phase 1 Habitat verification survey was undertaken in 2018, once the preferred route option had been determined, to identify any changes in habitat types relating to the Scheme. The Phase 1 verification survey was also limited by access constraints associated with health and safety concerns. It was not possible for surveyors to access the roadside verges of the A249 or M2 carriageways as lane closures would have been required. However, the majority of land adjacent to both carriageways was accessible, and therefore habitats were mapped wherever possible from adjacent land. The areas of land not able to be viewed from third party land included the highway boundary adjacent to residential properties on Maidstone road at the northern extent of the Scheme, and the fields opposite Honeycrock Hill and Amels Hill, on the east side of A249, at the southern extent of the Scheme. Habitat mapping was also informed by desktop information including aerial photographs and Ordnance Survey maps. Where on-site verification was not possible, the previous data collated to inform the Option Appraisal has been used to inform this assessment.

7.6.4 Following safety considerations for access to Bowl Reed Farm property on Oad Street, an additional private access was added to the Scheme in February 2019. Aerial photos were used to identify broad habitat features, and a ground truthing survey was carried out on 20th February 2019. Photographs were taken to help identify broad habitats, but given the time of year of the survey, it was not possible to classify the habitats to JNCC Phase 1 habitat categories. Where possible, inclusion of broad habitat features is identified in the baseline conditions, and precautionary assessment has been used to inform the potential for protected/notable species. Further survey will be carried out in 2019, during the appropriate survey season (April to September) to provide clarity on the habitat types, notable botanical species (if present) and to confirm the potential for protected species that has been determined in the assessment. The proposed new Bowl Reed Farm access affects a small area of land (approximately 184 m in length and 5.5 m wide), broad habitat features have been identified, and a precautionary assessment has been provided. Therefore,

the lack of detailed Phase 1 habitat survey results is considered unlikely to present a significant constraint to the assessment, as precautionary measures have been provided within the assessment.

7.6.5 No dedicated badger surveys have been undertaken to inform the Scheme due to access restrictions along the road verges due to health and safety concerns. Whilst it is recognised that survey guidance[134] states a corridor of approximately 250 m either side of the centreline of the road should be surveyed, it is also recognised that surveys should focus on potential impacts from fragmentation and loss of setts. The Scheme design requires a limited proportion of land take and remains generally on the route alignment of the existing A249 carriageway. Where badger evidence has been found during other protected species surveys, details and locations of badger evidence have been recorded and are provided in Appendix D.9 in Volume 2. Therefore, it is considered that the majority of badger evidence will have been captured, whist other species-specific surveys were carried out and such survey limitations are not considered significant.

7.6.6 During the 2017 bat surveys there were several limitations relating to equipment error or malfunction or poor weather conditions. These are detailed within Appendix D.5 in Volume 2. None of the limitations identified are considered to significantly affect the assessment.

7.6.7 Some additional limitations were encountered during the bat surveys carried out in 2018 which included restricted access to the M2 viaduct during the preliminary bat roost assessment; restricted access to one of the elevations of The Gatehouse property during the emergence survey; static detector recording failure for one of the locations on Transect 4 in September; and a difference in the types of equipment used between the 2017 and 2018 survey efforts. These limitations are such that additional control measures and data collection were possible to negate significant limitations to assessment (details of these can be found in Appendix D.5 in Volume 2).

7.6.8 During the update bat surveys to provide appropriate geographic coverage for the length of the Scheme, a full representative season of surveys was not possible in the 2018 survey season to meet standard best practice guidelines. The late start to the bat surveys could have resulted in early season roosts, including maternity roosts, being missed, as well as important foraging and commuting habitats. Taking the overall combined surveys from 2017 and 2018, it is considered unlikely that a roost of high conservation value or a particularly important commuting route or foraging area would have been missed, and this is not considered to represent a significant constraint to this assessment. For potential bat roosts, pre-construction surveys will be carried out to confirm the presence or likely absence of roosting bats and the requirement for a Natural England mitigation licence will be determined based on the survey results.

7.6.9 The requirement for wintering bird surveys was identified to inform the potential impacts to some qualifying features of international designated sites located within the wider landscape. This was part way through the wintering bird survey period (October to March) and therefore surveys did not commence until January 2019. As such, certain passage and migratory species such as woodcock and waxwing may have been missed, However, due to the number of repeated visits,

[134] Highways Agency (now Highways England) Design Manual for Roads and Bridges, Volume 10, Section 4 Part 2 Mitigating Against Effects on Badgers (February 1997) (HA 59/92)

it is considered that overwintering species that regularly use the survey area would have been recorded. Therefore, the results of these surveys can be used with confidence during analysis of potential impacts on overwintering birds resulting from the Scheme.

7.6.10 During the desk study assessment to determine whether veteran trees are present within or adjacent to the Scheme, the Woodland Trust Ancient Tree Hunt database was accessed. This data source provides records where trees have been identified by members of the public and specialists and verified by the Woodland Trust. Therefore, the database does not provide an exhaustive information for veteran trees in a given geographic area, but rather the locations of trees noted locally. Taking account of the Phase 1 habitat surveys carried out for the Scheme, and the limitations of the database, it is unlikely that veteran trees will have been missed during the desk study or field survey as part of this assessment and the limitation on data from the Woodland Trust is not considered a significant limitation.

7.6.11 The search for waterbodies within 500 m of the Scheme was undertaken by using Ordnance Survey plans and aerial photographs only. These sources may not show all waterbodies within 500 m of the Scheme boundary (for example, some garden ponds may not be shown on maps or aerial images) and therefore some waterbodies may not have been identified. However, it is considered that the majority of established waterbodies will have been identified as a result of this approach, and this is considered sufficient to determine the presence or likely absence of great crested newts within the Scheme.

7.6.12 Where access and data limitations have been encountered during the collection of baseline information for a receptor, the precautionary principle has been applied, whereby mitigation/compensation measures are provided to avoid/minimise the risk of any potentially adverse impacts. Based on this approach, none of the limitations outlined above are considered significant in terms of the assessment of effects.

7.7 Baseline conditions

Designated sites

Statutory designated sites

7.7.1 There are no European designated sites within 2 km of the Scheme or SACs within 30 km of the Scheme which list bats as one of the qualifying features.

7.7.2 Although Queendown Warren SSSI, North Downs Woodlands SAC and Wouldham to Detling Escarpment SSSI are located over 2 km from the Scheme, they are located within 200 m of the Affected Road Network (ARN)[135] and there is therefore the potential for air quality impacts in line with DMRB guidance[136], which states that SACs (SCIs or cSACs), SPAs, pSPAs, SSSIs and Ramsar sites located within 200 m of an ARN should be considered. This approach is

[135] The Affected Road Network (ARN) has been defined in accordance with HA 207/07 scoping criteria as set out in the Design Manual for Roads and Bridges Section 3 Part 1 (HA207/07), former Highways Agency, May 2007. Affected roads are those that meet any of the following criteria: Road alignment will change by 5 metres or more; or, Daily traffic flows will change by 1,000 annual average daily traffic or more; or, Heavy duty vehicle flows will change by 200 annual average daily traffic or more; or, Daily average speed will change by 10 kilometres per hour or more; or, Peak hour speed will change by 20 kilometres per hour or more.
[136] Highways England (2007) Design Manual for Roads and Bridges Volume 11 Section 3 Part 1 Air Quality07

further confirmed in recent Natural England guidance in which protected sites falling within 200 m of the edge of a road affected by a plan or project need to be considered[137]. Information about these sites is summarised in Table 7.4.

Table 7.4: Summary of statutory designated sites within the desk study area

Site name and value	Approximate distance and direction from the Scheme	Area (ha)	Description
Queendown Warren SSSI	160 m south of the M2 where it falls in the ARN category. 2.2 km northwest of Scheme extent.	22.2 ha	The grassland and woodland of this site support two nationally rare plant species as well as an outstanding assemblage of plants. Part of the SSSI is designated as a SAC. The SAC is situated south of Warren Lane, whereas the full extent of the SSSI includes land to the north of Warren Lane. The SAC is not located within 200 m of the ARN and air quality impacts would not extend over such a distance.
North Downs Woodlands SAC	10 m north of the A249 where it falls in the ARN category. 7 km southwest of Scheme extent.	288.58 ha	Annex I habitats that are a primary reason for site selection include: 9130 Asperulo-Fagetum beech forests This site consists of mature *Asperulo-Fagetum* beech forests and also yew 91J0 Yew *Taxus baccata* woods on steep slopes. The stands lie within a mosaic of scrub and other woodland types and are the most easterly of the beech woodland sites selected. Parts of the woods were affected by the Great Storm of 1987. 91J0 Taxus baccata woods of the British Isles * Priority feature. Yew woodland at this site is associated with 9130 *Asperulo-Fagetum* beech forests, scrub and small areas of unimproved grassland on thin chalk soils. Where the shade is not too dense dog's mercury predominates in the ground flora. The site is the most easterly of those selected. Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site include: 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites).
Wouldham to Detling Escarpment SSSI	10 m north of the A249 where it falls in the ARN category.	296.3 ha	This 10 km stretch of the chalk escarpment includes representative examples of woodland, scrub and unimproved grassland habitats on chalk which support a number of rare and

[137] Natural England (June 2018) Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitat Regulations.

Site name and value	Approximate distance and direction from the Scheme	Area (ha)	Description
	7 km southwest of Scheme extent.		scarce species of plants and invertebrates. This SSSI is located within the North Downs Woodlands SAC.

7.7.3 North Downs Woodlands SAC is of International or European value given its status as a European designated site, and Queendown Warren SSSI and Wouldham to Detling Escarpment SSSI are of **National value** due to their statutory designated status as SSSI's.

Non-statutory designated sites

7.7.4 There are five non-statutory designated sites within the desk study area. Table 7.5 below provides a description of each non-statutory designated site and they are shown on Figure 7.1 in Volume 3. There are two Roadside Nature Reserves (Honeycrock Hill, MA04 and Church Hill Stockbury, MA11) within the desk study area that are located within the Scheme boundary.

Table 7.5: Summary of non-statutory designated sites within the desk study area

Non-statutory designated site name	Approximate distance and direction from the Scheme	Size (ha)	Description summary (taken from citations provided by Kent and Medway Biological Records Centre)
Honeycrock Hill Roadside Nature Reserve (RNR) - MA04	Located within the Scheme boundary approximately 500 m west of the M2 Junction 5 (north of the A249).	0.1 ha	This site has an assemblage of chalk grassland indicator species, including bee orchid.
Church Hill, Stockbury RNR - MA11	Located within the Scheme boundary at the western end of the Scheme (north of the A249).	Approx. 0.2 ha	This site has a good selection of chalk grassland habitat indicator species, including a small population of man orchid. The site also supports reptiles and invertebrates including glow-worm.
Squirrel Wood, Stockbury Valley Kent Local Wildlife Site (LWS) - MA46	Located approximately 315 m south of the western end of the Scheme boundary (south of the A249).	109.38 ha	This site comprises substantial blocks of Ancient Woodland included on the provisional Ancient Woodland inventory with at least 36 Ancient Woodland vascular plant indicator species recorded. Grassland clearings of a neutral and acidic nature, some with heathland species, are also present.
Stockbury Wood LWS - MA35	Located approximately 670 m west of the western end of the Scheme boundary (north of the A249).	7.92 ha	The site consists of Ancient Woodland with 33 Ancient Woodland indicator plants recorded and four areas of chalk grassland road verge habitat with 24 unimproved chalk grassland indicator species recorded.

Non-statutory designated site name	Approximate distance and direction from the Scheme	Size (ha)	Description summary (taken from citations provided by Kent and Medway Biological Records Centre)
Queendown Warren Kent Wildlife Trust (KWT) Reserve	Located approximately 1.9 km northwest of the western end of the Scheme boundary (north of the A249).	75.96 ha	The original reserve site was a rabbit warren in medieval times and this forms the reserve core. Recent extensions include 16 ha of pasture and 40 ha of arable land. Species re-colonisation, seed sowing and grazing are helping restore wildlife-rich habitat to the site. This site is located adjacent to Queendown Warren SAC and SSSI.

7.7.5 Squirrel Wood LWS, Stockbury Wood LWS and Queendown Warren KWT Reserve are all located in excess of 300 m from the Scheme. They will not be subject to any direct impacts resulting from land take or vegetation clearance during construction of the Scheme. Indirect impacts are also not anticipated from, for example, noise pollution or air quality pollution during the construction or operational phases of the Scheme over such distances. In addition, there are no watercourses linking these non-statutory designated sites and the Scheme area that could act as a potential pathway for water pollution. Therefore, it is not anticipated that there is any risk that these non-statutory designated sites will be subject to adverse effects as a result of the Scheme. Consequently, Squirrel Wood LWS, Stockbury Wood LWS and Queendown Warren KWT have been scoped out of further assessment (including impact assessment).

7.7.6 Honeycrock Hill RNR and Church Hill, Stockbury RNR are located in close proximity to one another at the southern extent of the Scheme. They also form part of a network of RNR's along the A249 southward toward Maidstone, beyond the study area, and form part of a wider network of 89 km of RNR's within Kent. Although the extent is small, given the sites provide connectivity to the wider landscape surrounding the Scheme, and provide part of a wildlife corridor in this area of Kent, they are considered to be of **County value**.

Ancient Woodland

7.7.7 Six blocks of Ancient Woodland Inventory (AWI) woodland were identified within 1 km of the survey area; the nearest being Chestnut Wood and Church Wood which are located adjacent to the Scheme (see Figure 2.1 in Volume 3) and are summarised in Table 7.6.

Table 7.6: Summary of Ancient Woodland within the desk study area

Woodland name	Approximate distance from the Scheme	Size (Ha)	Description
Church Wood	Immediately adjacent to the northwest boundary of the Scheme, adjacent to the southbound on/off-slip of the M2 Junction.	6.2	Ancient and Semi-Natural Woodland.

Woodland name	Approximate distance from the Scheme	Size (Ha)	Description
Chestnut Wood	Immediately adjacent to the southeast boundary of the Scheme, adjacent to the northbound on/off-slip of the M2 Junction.	0.5	Ancient and Semi-Natural Woodland.
Squirrels Farm Wood	315 m south of the Scheme, south of the A249.	29.5	Ancient and Semi-Natural Woodland.
Steps Hill Wood	665 m southwest of the Scheme, north of the A249.	5.6	Ancient and Semi-Natural Woodland.
Gore Wood	740 m southeast of the Scheme.	8.95	Ancient and Semi-Natural Woodland.
Woodland ID: 1500570	815 m south of the Scheme.	0.48	Ancient and Semi-Natural Woodland.

7.7.8 The woodlands identified in the table above are included in Natural England's Ancient Woodland Inventory as areas of woodland likely to be present before A.D. 1600.

7.7.9 NVC surveys of Church Wood showed that sweet chestnut was the dominant canopy species with occasional pedunculate oak and silver birch. The understorey comprised occasional bramble, hazel, elder and common hawthorn. Flora within Church Wood varied, depending on the slope and soil condition. To the north and south, an abundance of wood anemone and bluebell were recorded, whereas to the east side of the wood, sparse ground flora with a higher proportion of bare earth and bramble were recorded.

7.7.10 Chestnut Wood is a semi-natural, broad-leaved, coppice woodland dominated by sweet chestnut with a range of occasional tree species including silver birch, pedunculate oak and ash. The ground flora was dominated by dog's mercury, with a range of occasional to rare broad-leaved herbs including primrose, bluebell and Enchanter's nightshade. With the exception of Enchanter's nightshade, these ground flora species are considered Ancient Woodland indicator plant species[138]. The woodland has been classified as a combination of NVC type W8b Fraxinus excelsior - Acer campestre - Mercurialis perennis woodland (Anemone nemorosa sub-community), on the basis that wood anemone is frequent, and bluebell is abundant. The other NVC classification being W8a Fraxinus excelsior - Acer campestre - Mercurialis perennis woodland (Primula vulgaris - Glechoma hederacea - sub-community) primarily on the basis that dog's mercury becomes more abundant at the expense of bluebell and wood anemone in places. It is likely that the woodland was last coppiced approximately 20 years ago, or more. The woodland is accurately mapped as Ancient Woodland on Natural England's Ancient Woodland Inventory.

[138] Ancient Woodland indicator species based on: Kent Wildlife Trust (2015). Local Wildlife Sites in Kent – Criteria for Selection and Delineation. V1.5. KWT.

7.7.11 Ancient Woodland is an irreplaceable habitat; there is strong planning policy protection for Ancient Woodland in the NPPF[139] and in the NN NPS.[140] The North Kent Downs AONB Management Plan[141] prioritises protection and enhancement of this habitat. Ancient Woodlands relevant to the Scheme (Church Wood and Chestnut Wood) are considered to be of **National value**. This evaluation is based on guidance set out in IAN 130/10 and takes account of the level of policy protection afforded to Ancient Woodlands under the NPPF 2019.

7.7.12 Squirrels Farm Wood, Steps Hill Wood, Gore Wood and the unnamed woodland (woodland ID: 1500570) are all located in excess of 300 m from the Scheme. They will not be subject to any direct impacts resulting from land take or vegetation clearance during construction of the Scheme. Indirect impacts are also not anticipated from, for example, noise pollution or air quality pollution during the construction or operational phases of the Scheme over such distances. In addition, there are no watercourses linking these Ancient Woodlands and the Scheme area that could act as a potential pathway for water pollution. Therefore, it is not anticipated that there is any risk that these Ancient Woodland sites will be subject to adverse effects as a result of the Scheme. Consequently, Squirrels Farm Wood, Steps Hill Wood, Gore Wood and the unnamed woodland (woodland ID: 1500570) have been scoped out of further assessment (including impact assessment).

Veteran or ancient trees

7.7.13 The Woodland Trust website identified no ancient or veteran trees within the desk study area. The closest ancient tree identified to the Scheme was a common yew tree located approximately 260 m north of the western end of the Scheme in the churchyard along Church Hill Road.

7.7.14 During the 2018 Phase 1 verification survey, and the subsequent arboricultural survey carried out in 2018, one veteran oak tree was recorded between the northern most boundary of Chestnut Wood and the boundary of the highway planting associated with the M2 westbound off-slip. Although the tree contains some defects, namely hollowing and the presence of wood decay fungus, its vitality is good and it is located in a sheltered position (see Appendix M in Volume 2 for Arboriculture Report).

7.7.15 Although the single veteran tree has some defects and wood decay fungus and is situated on the boundary of the Scheme, it forms part of a wider landscape biodiversity resource within a national context and is therefore considered to be of **National Value**. This evaluation takes account of the level of policy protection afforded to veteran trees within NPPF 2019.

Notable habitats

7.7.16 A total of five HPIs[142] were located within the desk study area: ponds, hedgerows, traditional orchard, lowland mixed deciduous woodland and lowland

[139] National Planning Policy Framework, Department for Communities and Local Government, 2019.
[140] National Policy Statement for National Networks, Department for Transport, December 2014.
[141] The Kent Downs Area of Outstanding Natural Beauty Management Plan 2014-2019, The Kent Downs Area of Outstanding Natural Beauty Partnership, April 2014.
[142] Habitat of Principal Importance for the conservation of biodiversity in England, as listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006).

calcareous grassland. In addition, HPIs are also Kent Biodiversity Action Plan (KBAP)[143] priority habitats.

7.7.17 Notable habitats recorded during the Phase 1 Habitat Surveys are described and valued below and mapped on the Phase 1 Habitat Survey map (Figure 7.2 in Volume 3).

Semi-natural broad-leaved woodland

7.7.18 Semi-natural broad-leaved woodland was recorded bordering both sides of the M2 carriageway and the eastbound off-slip and on-slip roads. Trees within the woodland comprised predominantly hazel and occasional mature oak.

7.7.19 The semi-natural broad-leaved woodland provides connectivity to Church Wood, a large block of AWI woodland directly south of the M2 carriageway. Another block of AWI woodland, Chestnut Wood, is situated between the M2 westbound off-slip and Oad Street. Church Wood and Chestnut Wood have been described above.

7.7.20 Semi-natural broad-leaved woodland habitat forms part of the habitat type 'lowland mixed deciduous woodland' which is a HPI. Woodland and scrub are also habitats within the KBAP. Although semi-natural broadleaved woodland is frequent in this part of Kent, it has declined in extent in Kent in the last 60years.[144] Taking account of these factors, non-ancient, broad-leaved, semi-natural woodland within the survey area is considered to be of **Local value**.

Broad-leaved plantation woodland

7.7.21 This woodland type was recorded throughout the survey area bordering both sides of the A249 carriageway and the M2 westbound off-slip and on-slip, within the centre of the M2/A249 roundabout, to the north of the M2 carriageway and the eastbound off-slip. Trees within the plantation woodland east of the A249 included predominantly young field maple, sycamore and sweet chestnut. Other species recorded included elder and hazel. Semi-mature plantation woodland west of the A249 comprised a greater species diversity, including those species detailed above as well as hawthorn, dogwood and cherry. Areas of this habitat type to the south of Oad Street comprised predominantly ash with occasional sycamore and silver birch.

7.7.22 The broad-leaved plantation woodland recorded is relatively young and isolated (with the exception of the Traditional Orchard near Pett Lane, as described below) and is unlikely to support rare or notable plant species.

7.7.23 These areas are recorded as the broad habitat type 'broadleaved, mixed and yew woodland' habitat in the Kent Habitat Survey 2012[145] and would fall under the HPI 'lowland mixed deciduous woodland' and also Woodland and Scrub within the KBAP. However, they do not meet the criteria for definition as a priority habitat[146] and due to their young age and low floristic diversity, plantation woodland is of **Local value**. The area of plantation woodland near the junction of Oad Street and Pett Lane comprised an area of well-established orchard with trees estimated to be approximately 60-70 years old. The orchard was

[143] Kent Biodiversity Action Plan (KBAP) (2005). http://www.kentbap.org.uk/
[144] Kent Biodiversity Action Plan (KBAP) (2005). http://www.kentbap.org.uk/
[145] http://webapps.kent.gov.uk/KCC.KLIS.Web.Sites.Public/ViewMap.aspx
[146] http://jncc.defra.gov.uk/page-5706

dominated by cherry species with occasional apple. Taking account of the spacing between the trees in the orchard and the age of the trees, it is likely to qualify as Traditional Orchard, a HPI and a KBAP priority habitat. Therefore, Traditional Orchards within the survey area are considered to be of **County value**.

Mixed plantation woodland

7.7.24 This woodland type was recorded east of the A249 bordering both sides of the M2 carriageway. Tree species recorded included predominantly yew and beech. Other occasional tree species recorded included elder, sycamore and hawthorn. The woodland exhibited a dense structure with a very sparse understorey and field layer.

7.7.25 Based on the species recorded, this woodland has an affinity to 'lowland beech and yew woodland' HPI type which occurs on chalk substrates in other parts of the Kent Downs Area of Outstanding Natural Beauty (AONB)[147].

7.7.26 Although 'lowland beech and yew woodland' is a HPI, the woodland recorded comprised only young or semi-mature beech and yew trees. In addition, the woodland was narrow, isolated and was immediately adjacent to the M2 carriageway and was therefore subject to high levels of pollution (including large amounts of litter). Given this, mixed plantation woodland within the survey area is considered to be of no more than **Local value**.

Semi-improved calcareous grassland

7.7.27 There were two distinct areas of semi-improved calcareous grassland, both at the southern extent of the Scheme located within Honeycrock Hill RNR and Church Hill, Stockbury RNR.

7.7.28 Chalk grassland habitat indicator species such as bee orchid, vervain, wild marjoram, wild basil, mouse-ear hawkweed, dwarf thistle, Fairy flax, tufted vetch and ploughman's spikenard have been recorded at Honeycrock Hill RNR[148].

7.7.29 At Church Hill RNR, fairy flax, hairy St. John's wort, mouse-eared hawkweed, yellow-wort wild marjoram and a small population of man orchids have been recorded[149].

7.7.30 Calcareous grassland is a HPI, is priority habitat within the KBAP and is in decline in Kent, primarily due to agricultural intensification or scrub development[150]. Although a notable habitat within the region, there were only two small areas of semi-improved calcareous grassland within the Scheme. Given their limited extent within the Scheme, their location immediately adjacent to the A249, and in line with the valuation of the associated RNRs, the areas of semi improved calcareous grassland are considered to be of **County value**. This evaluation takes account of the valuation of the RNR's (as identified in 7.7.6, above).

[147] M2 Junction 5 Improvements Scheme: Environmental Assessment Report, WSP, January 2017
[148] Roadside Nature Reserve Citation and Management Recommendations: Honeycrock Hill (2014), Kent Wildlife Trust
[149] Roadside Nature Reserve Citation and Management Recommendations: Church Hill (2014), Kent Wildlife Trust

[150] Kent Biodiversity Action Plan (KBAP) (2005). http://www.kentbap.org.uk/

Standing water

7.7.31 Two waterbodies are located within the Scheme boundary. These include a drainage lagoon close to the A249/Oad Street Junction (identified as GCN 1 on Figure 1 in Appendix D.4 in Volume 2). The waterbody appeared to be deep with steep sided banks and was dry and surrounded by nettles and scrub at the time of survey in 2016. An overgrown well was also identified within the Scheme boundary (identified as GCN 2 on Figure 1 in Appendix D.4 in Volume 2). This was overgrown with vegetation and held a very small amount of water.

7.7.32 Ponds are HPIs[151] although neither of the ponds within the study area would meet the criteria for definition as a priority habitat[152]. Nevertheless, ponds hold an intrinsic value for wildlife. It is considered that the drainage lagoon contributes somewhat to the local resource of this particular habitat type in the local area and acts as a 'stepping stone' for the dispersal of other species. It is considered to be of **Local value**.

7.7.33 The well was so small that its nature conservation value is considered to be of less than **Local value**.

Species-rich hedgerows

7.7.34 Three species-rich hedgerows were identified within the Scheme. Following a detailed hedgerow survey carried out in November 2018. All three were considered to be ecologically 'important' under the Hedgerows Regulations 1997, as follows:

- The hedgerow along Amel's Hill comprised six woody species listed on Schedule 3 of the Hedgerow Regulations per 30 m section. These comprised birch, blackthorn, dogwood, elder, hawthorn and holly;
- The defunct hedgerow on Honeycrock Hill included at least seven woody species listed on Schedule 3 of the Hedgerow Regulations per 30 m section. These comprised ash, blackthorn, cherry species, dogwood, elder, hawthorn, hazel, field maple, rose species and spindle; and
- The hedgerow recorded along Oad Street, close to Pett Lane comprised at least seven woody species listed on Schedule 3 of the Hedgerow Regulations per 30 m section. These comprised blackthorn, buckthorn, cherry species, dogwood, elder, hawthorn, hazel, field maple, rose species, spindle, wayfaring tree and whitebeam.

7.7.35 These three hedgerows are also identified within Chapter 11 Cultural Heritage and shown on Figure 11.2 in Volume 3 along with those hedgerows identified as important in accordance with the archaeology and history criteria of the Hedgerow Regulations (1997).

7.7.36 Hedgerows are HPIs and KBAP priority habitats. Given the species-rich and 'important' nature of the hedgerows within the study area, they are considered to be of **Local value**.

7.7.37 Full details of the hedgerow survey are included in Appendix D.7 in Volume 2.

[151] Habitat of Principal Importance for the conservation of biodiversity in England, as listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006).
[152] https://freshwaterhabitats.org.uk/projects/priority-ponds/priority-pond-criteria/

Other Habitats

7.7.38 The following habitats are not HPIs, but they provide corridors of habitat connectivity for the purpose of genetic exchange and dispersal of notable and protected species across the wider landscape. Such habitats are abundant throughout Kent, ubiquitous across the UK and are considered to be of **less than Local value** (i.e. of value within the Scheme area only) and are scoped out of further assessment as any potential impacts on these habitats are unlikely to be significant.

Dense/continuous scrub and scattered scrub

7.7.39 Scattered scrub was present throughout a field directly north of the M2 carriageway between the A249 and Maidstone Road. The scattered scrub was more dense and continuous towards the northern edge of the field. Species recorded comprised predominantly bramble with occasional dogwood.

7.7.40 An additional area of scattered scrub was present between the Traditional Orchard near Pett Lane and the adjacent field of semi-improved grassland. This linear patch of scattered scrub was dominated by hawthorn with frequent bramble and common nettle and with some elder.

7.7.41 Dense scrub was present along the southern side of Oad Street, immediately south of the M2 carriageway, with similar species recorded from elsewhere within the survey area.

7.7.42 Further additional scattered scrub was situated along the roadside verge of the northbound A249 carriageway, between Church Hill and the roundabout junction.

7.7.43 Dense and scattered scrub is a commonplace and widely distributed habitat throughout Kent and the UK and is considered to be of **less than Local value**. Therefore, this habitat type is not considered further as part of this assessment.

Poor semi-improved grassland

7.7.44 Multiple areas of species-poor semi-improved grassland occurred throughout the survey area, predominantly along the carriageway verges. A large area of this habitat type was present within a field directly north of the M2 carriageway between the A249 and Maidstone Road. Floral species recorded comprised perennial rye-grass, red fescue, false oat-grass, Yorkshire-fog, teasel, ground ivy, willowherb, bristly ox-tongue and creeping thistle.

7.7.45 This habitat was also present to the north of the M2 carriageway within land associated with the property located on Oad Street immediately north of the M2. Floral species recorded comprised perennial rye-grass with white clover, dandelion and buttercup species. At the time of the survey this area of grassland had just been cut and so further identification of species was not possible[153].

7.7.46 A further area of this grassland type was situated between Oad Street and the west bound off-slip for the M2 and sward diversity included birds foot trefoil, germander speedwell, meadow grass, a species of fescue, silver weed and wild thyme.

[153] M2 Junction 5 Improvements Scheme: Environmental Assessment Report, WSP, January 2017

7.7.47 Poor semi-improved grassland is a commonplace and widely distributed habitat throughout Kent and the UK. It is considered to be of **less than Local importance** and therefore not considered further as part of this assessment.

Tall ruderal

7.7.48 A single parcel of dense, tall ruderal vegetation was recorded surrounding the water body adjacent the A249/Oad Street junction. Plant species recorded included predominantly common nettle, teasel, bramble, white dead nettle and occasional willowherb.

7.7.49 Tall ruderal vegetation is a commonplace and widely distributed habitat throughout Kent and the UK and is considered to be of **less than Local importance**. Therefore, tall ruderal habitats are not considered further as part of this assessment.

Species Poor Hedgerows

7.7.50 A single species poor hedgerow was present along Oad Street to the southeast of Bowl-Reed farm, consisting entirely of young growth Leyland cypress.

7.7.51 Although hedgerows are HPIs and KBAP priority habitats, given the species poor nature of this hedgerow, and its young age, it is considered to be of **less than Local value**.

Arable

7.7.52 This habitat type was recorded throughout the survey area. Arable vegetation is typically poor in plant species diversity and is of limited nature conservation interest. Although lowland farmland is a priority habitat within KBAP, it is not a HPI. Given the paucity of field margins and the intensity of the crop management within the arable land within the study area, the habitat structure on-site is limited in its biodiversity, and therefore is considered to be of **less than Local value**.

7.7.53 This habitat type is therefore not considered further as part of this assessment.

Amenity grassland

7.7.54 Amenity grassland was recorded within the grounds of a property at the junction of Oad Street and Pett Lane. Species recorded included perennial ryegrass, daisy and dandelion.

7.7.55 Amenity grassland is commonplace and widely distributed throughout Kent and the UK and has little biodiversity value, is of **less than Local value** and therefore is not considered further as part of this assessment.

Notable and protected species

Notable flora

7.7.56 The desk study provided 197 records of protected species, comprising 23 different species, within 2 km of the Scheme. The majority of these records are within, or in the vicinity of Stockbury Valley woodlands, which includes Longreach Wood, Steps Hill Wood, Squirrel Wood and Hall Wood (118 records, comprising 16 species) or Queendown Warren (62 records, comprising 17 species).

7.7.57 The records included five species listed under Schedule 8 of the Wildlife and Countryside Act 1981 (as amended) and six species listed as Species of Principal Importance[154]. One species, fingered speedwell, is listed on both Schedule 8 and is also a Species of Principal Importance. This record was located at Steps Hill Wood during 2010, approximately 1.2 km southwest of the Scheme.

7.7.58 The Kent Wildlife Trust provided lists of plant species recorded within Honeycrock Hill RNR (MA04) and Church Hill, Stockbury RNR (MA11), both of which are located partially within the Scheme. Plant species included a number of calcareous grassland indicator species, including pyramidal orchid at Honeycrock Hill RNR and pyramidal orchid, bee orchid and man orchid at Church Hill, Stockbury RNR.

7.7.59 KMBRC provided additional records of 18 species of orchid; none of which were located within the Scheme boundary. The closest orchid records to the Scheme are broad-leaved helleborine located approximately 700 m northwest of the Scheme within an orchard north of Church Lane recorded in 2008.

7.7.60 Two species of orchid, pyramidal orchid and bee orchid, were recorded within and adjacent to the Scheme during the breeding bird surveys carried out by Atkins in 2018. The locations of pyramidal orchids were recorded both northeast and southwest of the M2 corridor, along the northbound and southbound verges of the A249. Only one location of bee orchid was recorded northeast of the M2, along the northbound verge of the A249, approximately 430 m east of the M2 eastbound off-slip. Neither species is a Species of Principal Importance or listed as a priority species on the KBAP.

7.7.61 Based on the desk study information available and the general habitat types within the Scheme, and excluding the flora associated with Honeycrock Hill RNR and Church Hill, Stockbury RNR; the flora within the Scheme is considered to be of **less than Local value**.

7.7.62 Nevertheless, mitigation design has taken into account the presence of orchids within the Scheme boundary, such that this resource can be used as part of the creation of new areas of species-rich grassland, thereby supporting the establishment of species diversity within the newly created grassland habitat. Details of the mitigation is included in Section 7.9.

Protected and notable species

Bats

7.7.63 The desk study revealed records of nine bat species from the wider area, with no records from within the Scheme, including; common pipistrelle, soprano pipistrelle, brown long-eared, noctule, Leisler's, serotine, Daubenton's, Natterer's and Bechstein's bat. The closest records were two unknown roost types located approximately 300 m west of the Scheme in the vicinity of Church Farm at the top of Church Hill, Amels Hill and Honeycrock Hill. In addition, a soprano pipistrelle maternity roost was located approximately 1.1 km to the south of the Scheme. No further information about this roost was provided.

[154] Species of Principal Importance for the conservation of biodiversity in England, as listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006).

7.7.64 One record of an individual Bechstein's bat was recorded ('in the hand') approximately 1.7 km south of the Scheme in 2010. No Bechstein's bat roosts were recorded within the study area. Bechstein's bat is listed on Annex II of the EC Habitats Directive, which requires designation of SACs to promote important populations. However, there are no designated sites within 2 km which are designated specifically on account of bats, and no SACs within 30 km where bats are a qualifying feature.

7.7.65 Following the preliminary bat roost assessment of buildings and structures, and the ground level tree assessment, emergence and re-entry surveys were undertaken for buildings and structures with low, moderate and high potential to support roosting bats and trees with moderate and high potential to support roosting bats (in accordance with Collins 2016). Of these, five properties, the M2 viaduct structure and three trees were identified with potential to support roosting bats. Two roosts of low conservation status[155] have been recorded to date: one a common pipistrelle day roost and the other a likely common pipistrelle day roost. Both roosts are located at the southern end of the Scheme, in properties that are situated adjacent to the A249 carriageway and beyond the Scheme boundary, just south of Oad Street. At the latter, a single bat was observed emerging but it was not possible to make a recording for species identification; although given that common pipistrelle was the most frequently recorded species during all surveys, it is considered likely that this is another common pipistrelle day roost. The roosts were recorded in neighbouring residential properties.

7.7.66 The viaduct structure offered potential to support roosting bats due to the location of pipework along the underside of the structure and a long gap running the width of the structure at the eastern abutment. Although not all surveys of the viaduct were possible during the 2018 survey season, no bats were recorded roosting within the structure and very low numbers of bats were recorded using the vegetation surrounding the structure.

7.7.67 No bats were recorded roosting in either of the two trees surveyed. The third tree was not surveyed as it was considered to offer low potential for roosting bats, and therefore did not require further survey[156].

7.7.68 Whilst the requisite number of survey visits have not been undertaken in relation to the viaduct and the two trees, given their assigned level of suitability in accordance with current best practice guidelines[157]; based on the suite of survey data collected during 2017 and 2018, it is considered unlikely that a roost of any more than low conservation status is present and roosting bats are therefore considered to be of **Local value**.

7.7.69 Low and moderate suitability foraging and commuting habitat was identified within and adjacent to the Scheme (see Figure 1 in Appendix D.5 in Volume 2). The transect and static surveys have identified common (common pipistrelle, soprano pipistrelle, brown long-eared, noctule) and rarer (Nathusius' pipistrelle, Leisler's, serotine, Natterer's, Brandt's and *Myotis* sp.) species of bats utilising the Scheme and adjacent habitats for foraging and commuting purposes. The rarer bats were typically associated with commuting behaviour, utilising the linear

[155] Mitchell-Jones et al. (2004) Bat Mitigation Guidelines. English Nature.
[156] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (2rd edn). The Bat Conservation Trust, London.
[157] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (2rd edn). The Bat Conservation Trust, London.

features such as hedgerows and woodland edge habitat whist commuting between more suitable habitat for foraging and roosting within the wider area.

7.7.70 Overall, low levels of activity were recorded. The suitability of habitats closest to the A249 and M2 appeared to the surveyors to be significantly reduced by both noise and lighting disturbance from these busy roads, evidenced by the locations with lowest levels of bat activity being those closest to these roads, particularly in locations with limited screening from existing vegetation, such as along Transect 2 adjacent to the M2 and at Transect 4 adjacent to the A249. However, both common and soprano pipistrelle appeared to be less affected by such pollution and were still recorded adjacent to the main road in low numbers. These species are more adapted for urban conditions to avoid predation due to their size and flight speed, hence their common national status (as assessed by Wray *et al*[158]).

7.7.71 Bat activity improved when moving further away from the main roads as expected, likely due to a decrease in noise and light pollution and an improvement in habitat when moving further into farmland (see Figure 2 in Appendix D.5 in Volume 2, for transect routes). Transect 3 supported the largest amount of bat activity with the static detector located adjacent to a hedgerow north of Oad Street recording the highest number of passes. This hedgerow offered good connectivity between blocks of woodland to the east and the southwest, as well as numerous farm buildings amongst connecting hedgerows and scattered trees/scrub. This hedgerow was likely being utilised as a commuting route between habitats used for foraging and roosting.

7.7.72 No Annex II species have been recorded during the surveys. Although a Bechstein's bat was recorded 1.7 km south of the Scheme in 2010, the habitats present within the Scheme are unlikely to be of significance for Bechstein's bats as there are no large areas of woodland within the Scheme. Bechstein's generally show preference for foraging, commuting and roosting in broadleaved woodlands predominantly comprising of oak and ash. There are large areas of broadleaved woodland to the south of the Scheme, such as Squirrel Wood (LWS) which comprises Ancient Woodland approximately 109 ha in size, which provide optimum foraging habitat for Bechstein's bats. Additionally, such large areas of optimum habitat will also provide suitable core sustenance zone[159] for Bechstein's that may be present. Therefore, taking account of the other species recorded, and wider landscape features beyond the Scheme, Bechstein's bats are considered highly unlikely to be present within or in the vicinity of the Scheme.

7.7.73 The diversity of species recorded was mainly common pipistrelle followed by soprano pipistrelle bats, with fewer brown long-eared bats and noctules and individual Leisler's, serotine, Natterer's, Brandt's and *Myotis* sp. Common and soprano pipistrelle are common and widespread bat species, brown long-eared bats are widespread in Kent and their status is 'common,' and noctule are widespread in much of England but are uncommon and declining in Kent[160].

[158] Wray et al. (2010) Valuing bats in ecological impact assessment
[159] Core Sustenance Zones (CSZ) refer to the quality and availability of habitat surrounding a communal bat roost which will have a significant influence on the resilience and conservation status of the colony using the roost. The CSZ for Bechstein bat is estimated to be 1km radius (BCT, 2016).
[160] Kent Bat Group www.kentbatgroup.org.uk (Accessed: January 2019).

7.7.74 Considering the location of the site, the fragmented nature of the surrounding woodlands, and disturbance from existing lighting/noise on the road network, the results of the bat surveys are as expected. Based on their status and distribution, the bat assemblage recorded, and taking account of the available survey data, a precautionary **Local value** is considered to be appropriate**.**

7.7.75 Full details of the bat survey methodologies and results are included in Appendix D.5 in Volume 2.

7.7.76 The additional small area for the Bowl Reed Farm access supports a species poor intact hedge of Leyland cypress, which offers limited foraging potential for bats due to it being of a single coniferous species but has the potential to provide commuting linkages for bats in the wider landscape. Although surveys for bats have not been carried out for this small area, taking account of the limited extent, and the anticipated limited use of the hedge by bats due to its coniferous species, the valuation for bats for the Scheme remains of local value.

Great crested newts (GCN)

7.7.77 A single historic record (from 1999) of a GCN was identified during the desk study by WSP (2017). This record was from approximately 2 km northeast of the Scheme. There are no designated sites within the search area designated specifically, or in part, for GCN.

7.7.78 Four waterbodies have been identified within 500 m of the Scheme; two located within 250 m of the Scheme (GCN 1 and GCN 2) and two located beyond 250 m of the Scheme (GCN 3 and GCN 4); see Figure 1, Appendix D.4 in Volume 2 for details.

7.7.79 Both waterbodies GCN 1 and GCN 2 were identified as having ‘poor’ suitability for GCN during the habitat suitability index (HSI) surveys. The eDNA survey carried out on GCN 1 was returned with a negative eDNA result for GCN. Waterbody GCN 2 was considered unsuitable for supporting GCN. Given the unsuitability and/or likely absence of GCN from these waterbodies, GCN are considered unlikely to be present in waterbodies within 250 m of the Scheme and consequently are unlikely to be present in terrestrial habitat within the Scheme.

7.7.80 Waterbodies GCN 3 and GCN 4 were assessed as having ‘poor’ suitability for GCN during the HSI surveys and a low likelihood of GCN being present. It is considered, even in the unlikely event that GCN are present in these waterbodies, given that GCN are generally associated with habitat within 250 m of a breeding pond[161], it is unlikely that any GCN present in these waterbodies would utilise terrestrial habitat within the Scheme boundary.

7.7.81 On the basis of the information collected, GCN are considered unlikely to be present in waterbodies within 500 m of the Scheme. As such, GCN are considered likely to be absent from within the Scheme and are therefore not considered further within this assessment.

[161] Natural England. An assessment of the efficiency of capture techniques and the value of different habitats for the great crested newt (ENRR576) http://publications.naturalengland.org.uk/publication/134002.

7.7.82 Full details of the GCN survey methodologies and results are included in Appendix D.4 in Volume 2.

Hazel dormouse (dormouse)

7.7.83 No recent (within the last ten years) records of dormice within 2 km of the Scheme boundary were provided by KMBRC as a result of the desk study. Although outside of the search area, KMBRC provided a record of a dormouse from 2012 located approximately 2.9 km southeast of the Scheme. Habitat in the location of the record appears to comprise woodland, scrub and an extensive hedgerow network, which provides suitable habitat for dormice. Several records were also provided from within Queendown Warren SAC located approximately 2 km northwest of the Scheme. The most recent record from this location was from 2006.

7.7.84 Dormouse surveys were carried out within three areas covering suitable habitats within and adjacent to the Scheme (these are shown in Figure 2, Appendix D.1 in Volume 2). Presence of dormouse was confirmed in all three survey areas. Although not all areas of woody vegetation within the Scheme were included within the survey area, given the positive result of dormice in all those that were surveyed, it has been assumed that dormice are present within all suitable (i.e. woody) habitats within the Scheme. This comprises broadleaved semi-natural woodland, plantation woodland, scrub and hedgerows.

7.7.85 Church Wood and Chestnut Wood provide optimal habitat for dormice. As such, it is considered that these areas provide the 'core habitat' for the species within the immediate wider area of the Scheme. It is recognised, however, that these woodlands are limited in extent[162]. Therefore, the less optimal hedgerow, scrub and plantation woodland habitats within and adjacent to the Scheme are likely to provide important supplementary habitat, providing dormice with linkages to the wider landscape.

7.7.86 The dormouse habitat within and adjacent to the Scheme is fragmented by existing roads, as shown in Figure 1 in Appendix D.1 in Volume 2. Nevertheless, dormice have been shown to cross roads[163] and it is considered possible that dormice move between survey area 1, survey area 3 and surrounding habitats by crossing narrower roads and passing beneath the M2 viaduct. With regard to survey area 2, it is considered possible that dormice in this area move beneath the M2 viaduct and cross narrower roads to access suitable habitat on the north side of the M2 and between the M2 westbound off/on-slip roads and the A249. However, given the A249 is a busy, dual-carriageway approximately 35 m wide, it is considered unlikely that dormice would cross it. Therefore, the interchange of animals between survey area 2 and survey areas 1 and 3 is considered unlikely. The potential movements of dormice around this fragmented landscape are shown in Figure 3 in Appendix D.1 in Volume 2.

7.7.87 Based on a literature review of dormouse densities and given the variation in habitat suitability within the Scheme and surrounding areas, a value of 2.2 adults per hectare is considered an appropriate density for the Scheme. As such, based on 13.5 ha of suitable dormouse habitat within and adjacent to the Scheme, a

[162] The Dormouse Conservation Handbook (2nd edition, 2006) states that woodlands smaller than 20 hectares are less likely to support dormice than larger sites, unless they are linked to other areas of suitable habitat.
[163] People's Trust for Endangered Species (2012) The Dormouse Monitor: Why didn't the dormice cross the gaps?

total number of 30 adult dormice are considered likely to be present. However, it should be noted that the number of dormice likely to be affected by the proposed works is considered to be lower than this population estimate.

7.7.88 Given the high level of protection afforded to dormice, their rarity and declining status[164], but also considering the variation in habitat suitability within the Scheme and surrounding areas, and that they are widespread in Kent, the dormouse population within the study area (which includes the survey areas, the Scheme and adjacent connecting habitats not included in the survey areas) is considered to be of **County value**.

7.7.89 Full details of the dormouse survey methodologies and results are included in Appendix D.1 in Volume 2.

Breeding birds

7.7.90 The desk study identified recent records of 59 different bird species within 1 km of the Scheme. This comprised 48 species recorded within the breeding season (i.e. April to July inclusive). Of the records, 22 species are notable, which includes; three species on Schedule 1 of the Wildlife and Countryside Act 1981 (hobby, Mediterranean gull and fieldfare), nine species on the Birds of Conservation Concern (BOCC) Red List[165], seven species on the BOCC Amber list, eight Species of principal Importance[166] and thirteen species noted as key bird species in the KBAP[167]. Forty of these species have been confirmed by the Kent Ornithological Society (KOS) as breeding within the study area. The results from the surveys can be seen within Figures 1-4 in Appendix D.3 in Volume 2.

7.7.91 Breeding bird surveys undertaken identified a total of 42 species, twenty of which are notable[168]. The study area for the breeding bird surveys included all habitats that could be used by breeding birds within the Scheme boundary and up to 100 m from the Scheme boundary.

7.7.92 Of the 42 species recorded; 36 species were recorded within the study area, two species (skylark and kestrel) were recorded just outside the study area but at least part of their territories are considered to be within the study area, and the remaining four species were recorded outside of the study area where no part of their territories are within the study area.

7.7.93 Of the 38 species recorded within or just outside of the study area; 17 species were recorded as breeding species, 13 were recorded as probable breeding species, six were recorded as possible breeding species and the remaining two species were recorded as non-breeding species.

7.7.94 The assemblage of breeding birds recorded within the study area is considered typical for the habitats present (woodland and scrub, agricultural habitats and built-up areas within Kent) and the majority of these species are considered to be

[164] As set out in the Dormouse Technical Appendix, Appendix D.1 in Volume 2.
[165] Eaton MA, Aebischer NJ, Brown AF, Hearn RD, Lock L, Musgrove AJ, Noble DG, Stroud DA and Gregory RD (2015) Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. British Birds 108, 708–746. Available at: www.britishbirds.co.uk/wp-content/uploads/2014/07/BoCC4.pdf
[166] Species of Principal Importance for the conservation of biodiversity in England, as listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006).

[167] Kent Biodiversity Action Plan Steering Group (1997) The Kent Biodiversity Action Plan: A framework for the future of Kent's wildlife. Available at: https://www.medway.gov.uk/downloads/file/279/kent_biodiversity_action_plan
[168] As defined in the Bird Technical Appendix, Appendix D.3 in Volume 2.

common and widespread within Kent and the UK. Given the size of this study area, the numbers of individuals of common species are generally what could be expected in this part of the country[169,170].

7.7.95 The presence of semi-natural broadleaved woodland within the study area has resulted in the recording of associated notable species including great spotted woodpecker, green woodpecker, hobby and song thrush. Notable species associated with agricultural habitats include linnet, skylark, stock dove and yellowhammer, and those associated with built-up areas include house sparrow, jackdaw and starling.

7.7.96 The breeding bird assemblage within the study area is considered to be of **Local value**.

7.7.97 Full details of the breeding bird survey methodologies and results are included in Appendix D.3 in Volume 2.

7.7.98 The additional small area for the Bowl Reed Farm access supports a species poor intact hedge of Leyland cypress, which offers limited nesting and foraging potential for breeding birds due to it being of a single coniferous species. Given the late addition of this area to the Scheme design, the hedge was not included in the scope for the breeding bird survey. Taking account of the limited extent, and the anticipated limited use of the hedge by breeding birds, the valuation for breeding birds for the Scheme remains of **Local value**.

Wintering birds

7.7.99 The desk study identified records of bird species including lapwing, which forms part of the overwintering waterfowl assemblage qualification for the Medway Estuary and Marshes SPA. This site is located beyond the desk study search area (2 km). However, the lapwing records identified a potential that birds from the Medway Estuary and Marshes SPA could be using land within and adjacent to the Scheme boundary which could in turn mean that there is a functional linkage to the designated site. Three wintering bird surveys were carried out in January and February 2019 to assess this likelihood.

7.7.100 The wintering bird survey identified a total of 44 species, twenty-two of which are notable[171]. The survey area for the wintering bird survey included all habitats that could be used by overwintering birds within the Scheme boundary and up to 300 m from the Scheme boundary.

7.7.101 The assemblage of wintering birds is considered to be largely typical of agricultural areas, woodland and scrub and built-up areas within Kent.

7.7.102 The presence of agricultural habitats such as arable fields, hedgerows and improved grassland within the survey area has resulted in the recording of associated notable species including bullfinch, meadow pipit, skylark, stock dove, wintering thrushes and gulls.

[169] Kent Ornithological Society (2018) Kent Bird Report 2016.
[170] Clements, R., Orchard, M., McCanch, N. and Wood, S. (2015) Kent Breeding Bird Atlas 2008-13. Kent Ornithological Society.
[171] Notable species are taken as principal species for the conservation of biodiversity listed under Section 41 of the Natural Environment and Rural Communities Act 2006; those on the Red and Amber lists of Birds of Conservation Concern 4 (BoCC); species listed on Annex I of the Directive 2009/147/EC (the Birds Directive) and species listed under the Kent Local Biodiversity Action Plan.

7.7.103 Notable species associated with semi-natural broadleaved woodland include great spotted woodpecker, green woodpecker, mistle thrush and song thrush; and those associated with built-up areas include house sparrow, jackdaw and starling.

7.7.104 No qualifying species of the relevant Natura 2000 site were recorded during the 2019 surveys. A total of seven recent records (i.e. since 2009) of lapwing, within 2 km of the Scheme, were identified during the desk study; only one of which was within the survey area. As such, it is considered that the habitats within the survey area are not functionally linked to any of the Natura 2000 sites. Therefore, these designated sites are not considered further.

7.7.105 The wintering bird assemblage within the survey area is considered to be of **Local value**.

7.7.106 Full details of the wintering bird survey methodologies and results are included in Appendix D.6 in Volume 2.

Reptiles

7.7.107 The desk study identified two recent records of slow-worm within 1 km of the Scheme, the closest of which is located approximately 500 m southwest of the Scheme. The other was from approximately 700 m northeast of the Scheme. Both records appeared to be in close proximity to the A249.

7.7.108 There were no recent records of grass snake or common lizard within 1 km of the Scheme.

7.7.109 Three recent records of adder within 1 km of the Scheme were provided. These were from within or close to Church Hill, Stockbury RNR which is situated partially within the Scheme, with the adder records being located approximately 120 m southwest of the Scheme boundary. All three records were from 2014. The citation for Church Hill, Stockbury RNR states that reptiles have been recorded within this site.

7.7.110 A single area was surveyed in 2017 (identified in Figure 1 in Appendix D.2 in Volume 2), which comprised the most extensive area of suitable habitat for reptiles which was identified by the WSP extended Phase 1 habitat surveys carried out in 2015, 2016 and 2017. The survey area included the field located to the east of the M2 on the southern side of the A249. The northern, southern and western edges of this field are located within the Scheme boundary.

7.7.111 The survey area is considered to be a representative example of suitable habitat for reptiles within the Scheme as a whole, including the Bowl Reed Farm access, which offers some limited habitat with potential to support reptiles. Based on the results from the reptile survey, it is considered likely that low populations of slow-worm and common lizard are present within suitable habitat throughout the Scheme.

7.7.112 Based on the desk study data, adders may also be present within the Scheme, but none were recorded during the field surveys. The location of the desk study records compared to the survey area suggests that adders are likely to be predominantly associated with the southern extent of the Scheme on the

northern side of the A249, in the vicinity of Church Hill, Stockbury RNR, where the highway verge is wider with a south-facing slope.

7.7.113 Slow-worm and common lizard are the most widespread and common UK reptile species, although they are declining[172]. Adders are a widespread species throughout the UK[173] and are locally common, particularly in southern England. However, this species has also declined over much of England[174]. In Kent adders are not evenly distributed across the county and have a close association with calcareous grassland. As a result of the low numbers of reptiles likely to be present and given that slow-worm and common lizard, in particular, are common and widespread species, the reptile population within the Scheme is considered to be of **Local value**.

7.7.114 Full details of the reptile survey methodologies and results are included in Appendix D.2 in Volume 2.

Badger

7.7.115 A total of twelve recent records of badgers were identified within the desk study area. This comprised six records located within or immediately adjacent to the Scheme boundary (i.e. potentially Road Traffic Accidents (RTAs)). The records do not provide details of any setts present within the desk study area.

7.7.116 An active, main badger sett was identified during the Phase 1 Habitat verification survey carried out by Atkins in November 2018. This sett was located along Amel's Hill track at the western end of the Scheme, north of the A249 and east of Church Hill Road, approximately 150 m north of the Scheme boundary. The sett was located between a double hedgerow, behind a barbed wire fence, spanning approximately 50 m along the hedge. The sett comprised 14 entrances, three of which were disused, the remaining eleven of which all had leaf litter present but badger guard hairs on top of the leaf litter suggesting regular use by badgers. Evidence of badger foraging was also present between the two hedges as well as well-used paths and a large latrine located close by. A dead adult badger was found close to one of the main sett entrances in between the two hedgerows. No further badger setts have been identified within or adjacent to the Scheme.

7.7.117 Taking into account the limitations described in Section 7.6 above, no additional badger setts have been identified in the survey area. Where badger evidence has been found during other protected species surveys, which have included land either side of the Scheme, details and locations of badger evidence have been recorded and are included in Figure 1 in Appendix D.9 in Volume 2. Appendix D.9 is a confidential appendix as it contains sensitive data.

7.7.118 During breeding bird surveys carried out by Atkins in 2018, other evidence of badger was recorded including: a latrine located approximately 170 m northwest of the Scheme and a mammal path (likely to be badger) located within the Scheme approximately 500 m east of the M2 along the northern side of the

[172] Highways Agency (now Highways England) May 2005 Design Manual for Roads and Bridges, Volume 10, Section 4 Part 7 Nature Conservation Advice in Relation to Reptiles and Roads (HA 116/05)
[173] www.arc-trust.org/adder
[174] www.kentarg.org/reptiles

A249. Currently all the evidence of badgers is from the northern side of the A249.

7.7.119 The additional small area for the Bowl Reed Farm access supports a species poor intact hedge of Leyland cypress. No surveys for badgers in this location have been carried out to date. The hedge offers limited potential for sett creation and the farmland adjacent to Oad Street offers some foraging opportunities for badgers.

7.7.120 Badgers are widespread and common in Kent[175] and the UK and are not included as Species of Principal Importance or in the Kent BAP. However, due to their status and the legal requirements for their protection, populations of badger are of **Local value**.

7.7.121 The only badger sett identified is located 150 m from the Scheme and impacts to the sett are not anticipated as a result of the works. The Scheme is situated within a wider arable and woodland landscape which provides significant foraging resources for badgers locally. There are limited desk study records of badgers within the study area no significant crossing point of the A429 has been indicated by frequent records of RTAs. The Scheme design does not cause severance of existing habitat used by badgers locally and no severance of badger habitat is anticipated.

7.7.122 Taking account of the presence of badgers within 150 m of but not directly impacted by the Scheme, badgers are not considered further in this assessment. General mitigation measures to be implemented during construction will reduce the likelihood of incidental killing or injury of badgers (or other animals) which may be passing through the Scheme during construction. These measures are set out in Section 7.9.

Invertebrates

7.7.123 A total of 75 recent records, comprising 23 species of invertebrates were identified within the desk study area. Three species recorded (stag beetle, small blue butterfly and silver-spotted skipper) are protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). Stag beetle and small blue butterfly are also listed as Species of Principal Importance[176]. The closest, and only, records were from Queendown Warren located approximately 2 km from the Scheme boundary, with the most recent stag beetle record being from 2014 and the most recent records for small blue butterfly and silver-spotted skipper being from 2012. One record of hornet robberfly, a Species of Principal Importance, from Queendown Warren in 2014, was also provided.

7.7.124 Through review of the two RNR citations, only 22 species of common or low priority invertebrates have been recorded within the sites, including common butterfly, moth and bee species, wasp spider and glow-worm. Records of common or low priority invertebrate species were not requested from the local records centre.

7.7.125 No detailed invertebrate surveys have been carried out as the general habitat types within the Scheme boundary are common and widespread in the

[175] http://www.kentwildlifetrust.org.uk/species/badger
[176] Species of Principal Importance for the conservation of biodiversity in England, as listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006).

geographic region and are considered unlikely to support notable species. Furthermore, the desk study identified habitats and designated sites within the wider geographic area of the Scheme which support notable or rare species of invertebrates.

7.7.126 Based on the desk study information available and the general habitat types within the Scheme, the invertebrate population within the Scheme is considered to be of less than local value and they have been scoped out of further assessment (including impact assessment). Nevertheless, mitigation design has taken into account the presence of common invertebrates within the Scheme and includes measures that will be of benefit to invertebrates.

Non-native invasive plant species

7.7.127 A number of plant species listed under Schedule 9 of the Wildlife and Countryside Act 1981 were identified within the study area during the desk study. The plant species included Japanese knotweed, giant hogweed, Himalayan balsam, variegated yellow archangel and a cotoneaster species.

7.7.128 A species of cotoneaster was recorded within the survey area during the 2016 survey: on the northeast corner of the M2/A249 roundabout bordering the northern edge of the M2 westbound on-slip. It was not possible to confirm whether this was one of the five species listed on Schedule 9 of the Wildlife and Countryside Act 1981, as fruiting and flowering material was not in evidence at the time of survey making vegetative identification difficult.

7.7.129 No evidence of other Wildlife and Countryside Act 1981 Schedule 9 invasive plant species has been recorded within the survey area.

7.7.130 Non-native invasive plant species are not an important nature conservation receptor and therefore will not be subject to valuation. However, they will be considered in the assessment due to the requirement to adhere to laws controlling the spread of such species.

7.8 Potential impacts

7.8.1 Nature conservation receptors that were not recorded in the initial desk study and survey areas have been scoped out of further assessment, as they will not be affected by any activities or processes involved in the Scheme. This includes GCN and badgers. Similarly, nature conservation receptors that were recorded in the initial desk study and survey areas, but which would obviously not be affected by the Scheme, for example due to the distance between the Scheme and the receptor, have also been scoped out of further assessment. These include Squirrel Wood LWS, Stockbury Wood LWS, Queendown Warren KWT reserve and a number of Ancient Woodland sites located in excess of 300 m from the Scheme.

7.8.2 Habitats, species and species groups that are not subject to legislative protection and have a nature conservation value in the context of the Scheme area only are not considered important ecological receptors. Impacts on these receptors are unlikely to have a significant effect on the conservation status of these habitats or species. These receptors have therefore been scoped out of further assessment. This includes habitats grouped together as ‘other’ habitats, invertebrates and flora.

7.8.3 Once the data gathering exercises from both the desk study and field surveys were completed and all Scheme details were available, the EZoI was finalised for the remaining important ecological receptors during both the construction and operational phases of the Scheme, as detailed below.

Designated sites, Ancient Woodland, veteran trees and habitats

7.8.4 The Scheme involves the improvement of Junction 5 of the M2, including the slip roads associated with this junction from and to the A249. The generally localised nature and level of the impacts of the construction and operational works means that potential impacts (excluding air pollution) from the Scheme on designated sites, Ancient Woodland, veteran trees and habitats will be restricted to within or directly adjacent to the Scheme boundary. There are three designated sites that fall within 200 m of the ARN and which could potentially experience air quality impacts.

7.8.5 In setting the final EZoI for designated sites, it has been assumed that best practice pollution prevention guidelines will be implemented, such as Pollution Prevention for Businesses guidance [177].

Notable and protected species

7.8.6 The final EZoI for notable and protected species recorded within the Scheme area has been defined on a species-specific basis, based on the likely effects of the Scheme, as detailed in Table 7.7 below (distances are taken from the Scheme boundary, which comprises all land required for the Scheme and is based on Design Fix 3 [178]).

Table 7.7: Final EZoI for impact assessment on notable and protected species

Species	Distance from the Scheme boundary		Justification
	Construction	Operation	
Bats	100 m	100 m	There are no SACs designated for bats in 30 km and therefore the EZoI has been reduced to the geographic scope in proximity to the Scheme. Two unknown roost types have been identified in the wider local area, 300m west of the Scheme. Taking account of the matrix of suitable interconnective habitats in the wider landscape and beyond the Scheme extent and given there is no indication from survey evidence that bat foraging or commuting routes cross the Scheme, the EZoI is not considered necessary to extend beyond 100 m as bats in the wider area can utilise foraging and commuting habitats that are not part of the Scheme.
Dormouse	100 m	Scheme boundary	Impacts on dormice could occur through habitat loss and disturbance. There is

[177] Guidance for Pollution Prevention for Business, Defra and EA, published July 2016. https://www.gov.uk/guidance/pollution-prevention-for-businesses#construction-inspection-and-maintenance
[178] Including land required for haul roads, site compounds, material storage areas etc.

Species	Distance from the Scheme boundary		Justification
	Construction	Operation	
			potential that habitat loss could fragment corridors of habitat providing links to suitable habitat beyond the footprint of the Scheme. Once operational, dormice are frequently found in roadside habitats so potential impacts will not extend beyond the Scheme boundary.
Breeding birds	100 m / 500 m	Scheme boundary	Construction disturbance could potentially deter birds from breeding immediately adjacent to the Scheme boundary. However, this deterrence is likely to be extremely localised and impacts are expected to be limited to within 100 m of the Scheme boundary. Once operational, disturbance is likely to be limited to within the Scheme boundary itself.
Wintering birds	100 m / 300 m	Scheme boundary	Construction disturbance could potentially deter notable species from roosting and foraging adjacent to the Scheme boundary, up to a distance of 100 m for certain species, particularly those that utilise open habitats. This could extend to 300 m for any species of wildfowl and waders susceptible to disturbance that are present within the vicinity of the Scheme. Once operational, disturbance is likely to be limited to within the Scheme boundary itself.
Reptiles	Scheme boundary	Scheme boundary	Impacts on reptiles would occur as a result of habitat loss. Given that the adjacent habitats will be retained, and the Scheme will not cause habitat fragmentation, impacts to reptiles will be confined to the Scheme boundary. Once operational, impacts will be limited to within the Scheme boundary itself.

7.8.7 For invasive non-native plants, construction works will be confined to the Scheme boundary and therefore the risk of spreading non-native invasive plant species will also be confined to the Scheme boundary.

Impact assessment

7.8.8 The potential impacts, prior to mitigation during construction and operation of the Scheme are detailed below.

Designated sites

7.8.9 During construction, there will be direct loss of habitat within Honeycrock Hill RNR (0.08 ha lost) and Church Hill, Stockbury RNR (0.15 ha lost). If there were no mitigation there would also be potential for impacts to these RNRs where they are located outside of the Scheme boundary, but adjacent to it, through habitat degradation as a result of pollution from increased dust during construction, a pollution incident during construction, or groundwater pollution (i.e. changes in

soil quality through contamination) during construction. Given that these RNRs are already adjacent to a busy road, and already experience some degree of pollution from passing traffic, it is anticipated that this will continue.

7.8.10 Indirect impacts during operation include a potential for increases in air pollution due to increased volume of traffic as a result of the Scheme. However, based on the findings in the HRA results, this is unlikely to be significant and therefore potential increases in air pollution are not considered to be significant and there will be no additional operational phase impacts associated with the Scheme.

7.8.11 The Scheme has the potential to result in habitat degradation as a result of air quality impacts to Queendown Warren SSSI, North Downs Woodlands SAC and Wouldham to Detling Escarpment SSSI.

7.8.12 Critical loads and critical levels are a tool for assessing the risk of air pollution impacts to ecosystems. The critical load relates to the quantity of pollutant deposited from air to the ground, whereas the critical level is the gaseous concentration of a pollutant in the air. A principal function of the Air Pollution Information System (APIS) website[179] is to provide access to critical loads/levels and pollutant information.

7.8.13 Critical load values for nutrient nitrogen deposition are provided as a range, by habitat type, for use in detailed impact assessments in the UK. The MAGIC website[180] and the Natural England website[181] identified that habitats within Queendown Warren SSSI within 200 m of the ARN comprise ancient semi-natural woodland (broadleaved, mixed and yew woodland) and lowland calcareous grassland. Critical loads for these habitat types taken from the APIS website are as follows:

- Broadleaved, mixed and yew woodland Critical Load 15 – 20 kg N/ha/yr; and
- Calcareous grassland Critical Load 15 – 25 kg N/ha/yr.

7.8.14 Critical Levels for air pollutants are not habitat specific, as in critical loads, but have been set to cover broad vegetation types, often with critical values set for sensitive lichens and bryophytes. The policy of the UK Statutory nature conservation agencies is to apply a value of 30 µg NOx/m^3 annual mean for internationally designated sites and SSSIs on a precautionary basis[182].

7.8.15 Widely accepted environmental benchmarks for imperceptible impacts are set at 1% of the critical load or level. This is considered by Natural England's air quality specialists to be suitably precautionary, as any emissions below this level are considered to be imperceptible[183].

7.8.16 The Scheme would result in a maximum change in nitrogen deposition of 0.01 kg N/ha/yr within Queendown Warren SSSI. Taking the lowest critical load value of 15 kg N/ha/yr, this is a change of 0.07%, so below the 1% threshold. Furthermore, as described in the Air Quality chapter (Chapter 5), in relation to Queendown Warren SSSI, NOx concentrations are not estimated to exceed the

[179] APIS website: http://www.apis.ac.uk. Accessed: March 2019
[180] Magic Website: http://www.magic.gov.uk/. Accessed: March 2019
[181] Natural England Website: https://designatedsites.naturalengland.org.uk/. Accessed: March 2019
[182] Highways England (2007) Design Manual for Roads and Bridges Volume 11 Section 3 Part 1 Air Quality
[183] Natural England Internal Guidance - Approach to advising competent authorities on the assessment of road traffic emissions and HRAs V1.4 Final – June 2018

critical level for vegetation of 30 µg/m³ in either the base year (2016) or opening year (2022), both with and without the Scheme. Adverse impacts to Queendown Warren SSSI as a result of air quality are therefore not anticipated.

7.8.17 The assessment of air quality effects on North Downs Woodlands SAC (within which Wouldham to Detling Escarpment SSSI is located) is detailed in the Habitats Regulations Assessment report in Appendix D.6 in Volume 2. The HRA concludes that there are no likely significant effects for North Downs Woodlands SAC (or any other European sites).

Ancient Woodland

7.8.18 Based on the current Scheme design and existing data, there will be no habitat loss from Chestnut Wood or Church Wood Ancient Woodlands. This has been possible through preliminary design efforts to avoid such losses.

7.8.19 At Chestnut Wood, construction works will be at least 30 m away from this small Ancient Woodland fragment. Existing buffering vegetation comprising broad-leaved plantation woodland is present between Chestnut Wood and the construction works, and also extends along the M2 westbound off- and on-slip roads. This buffering vegetation will be retained. Natural England and the Forestry Commission's standing advice[184] states that a minimum buffer zone of 15 m is required to prevent root damage to Ancient Woodlands and should comprise semi-natural habitats such as woodland. It also states that where assessment shows other impacts are likely to extend beyond this distance (for example, the effect of air pollution from development that results in a significant increase in traffic), a larger buffer zone is likely to be needed. The buffer zone provided would ensure that Chestnut Wood is adequately protected from: physical damage to tree roots; increased dust during construction, a pollution incident during construction, and/or groundwater pollution (i.e. changes in soil quality through contamination) during construction.

7.8.20 Similarly, at Church Wood, construction works will be at least 50 m from this area of Ancient Woodland. There is currently limited buffering habitat, provided by the block of Ancient Woodland bordered by an arable field. Despite this, no impacts to Church Wood are anticipated over such a distance during construction.

7.8.21 Indirect impacts during operation include potential for decreases in air quality due to an increased volume of traffic as a result of the Scheme. The HRA for the Scheme concludes no likely significant effect as a result of increased air pollution on North Downs Woodlands SAC, which supports yew-dominated woodland and beech forests (see Appendix D.6 in Volume 2 for detail). The SAC is located 10 m from the ARN and the habitats present are likely to be more sensitive to air pollution than Church Wood and Chestnut Wood given the presence of yew-dominated woodland as a qualifying feature of the SAC.

7.8.22 Mitigation measures include advanced woodland planting adjacent to Church Wood, thereby supplementing the existing buffering vegetation and ensuring the integrity of this area of Ancient Woodland is maintained throughout the construction period. Considering the findings of the HRA and the buffer zones and buffering habitat, potential impacts on Chestnut Wood and Church Wood as a result of increases in air pollution are not considered to be significant.

[184] https://www.gov.uk/guidance/ancient-woodland-and-veteran-trees-protection-surveys-licences. Accessed: March 2019

Therefore, there will be no operational phase impacts on these receptors associated with the Scheme.

Veteran trees

7.8.23 Construction works will be at least 40 m away from the veteran tree at the northern boundary of Chestnut Wood. Existing buffering vegetation comprising broadleaved plantation woodland is present between this tree and the construction works, and also extends along the M2 westbound off- and on-slip roads. This vegetation will be retained. Natural England and the Forestry Commission's standing advice[185] states that a buffer zone around a veteran tree should be at least 15 times larger than the diameter of the tree, or 5 m from the edge of the tree's canopy, whichever is greater, and should comprise semi-natural habitats such as woodland. Based on the current Scheme design and existing data, there will be no loss of veteran trees. The veteran tree is 120 cm in diameter, so the buffer zone is considered to adequately protect this tree in line with current best practice guidance.

Habitats

7.8.24 The Scheme will result in loss of approximately 23 ha of habitat comprising; 5.4 ha of woodland, 0.75 ha of scrub, 5.1 ha of grassland habitats, 12 ha of arable land, as well as the loss of 1142 m of hedgerow and 250 m of dry ditch. A pond will also be lost. The areas of habitat loss are provided in the Table 7.8 below.

Table 7.8: Habitat losses and gains

Habitat type	Area or linear metres lost	Area or linear metres created
Woodland, comprising broad-leaved semi-natural woodland, broad-leaved plantation woodland and mixed plantation woodland	5.4 ha	6.09 ha
Scrub	0.75 ha	2.63 ha
Semi-improved calcareous grassland	0.23 ha	2.86 ha
Poor semi-improved grassland, tall ruderal and amenity grassland	4.88 ha	7.37 ha
Arable	12 ha	0 ha
Hedgerows	1142 m	3778 m
Dry ditch	250 m	3266 m
Pond	342 m^2	50 m^2
*the habitat calculations do not take account of 0.1ha of grassland not identified to Phase 1 habitat type.		

7.8.25 Loss of arable habitat will be permanent, but this habitat is not considered to be of particular nature conservation value (demonstrated by its value within the Scheme area only).

[185] https://www.gov.uk/guidance/ancient-woodland-and-veteran-trees-protection-surveys-licences. Accessed: March 2019

7.8.26 The loss of the remaining habitats is considered to be temporary as the mitigation measures include for habitat creation measures to be provided prior to construction and during construction for all habitats. The extent of each habitat type will be increased post-construction, with the exception of the pond. This, and given that the species diversity will also be enhanced in any new planting (see Preliminary Environmental Design drawings, Figure 2.3 in Volume 3, for detail), will result in terrestrial habitats with improved biodiversity value.

7.8.27 In order to achieve no overall loss of woodland habitat as a result of the Scheme, the Scheme boundary was extended to encompass adjacent arable habitat parallel to the A249 and Church Hill Road. A new pond will be created within the complex of drainage ditches and infiltration ponds close to its original location. Stretches of 'important' hedgerows will be translocated in order to retain their biodiversity value and will form part of the new hedgerows or linear habitat features.

7.8.28 If there were no mitigation, the Scheme would have potential to result in indirect impacts (i.e. habitat degradation) to woodland habitat, grassland habitat and the other habitats being retained resulting from dust during construction and surface and/or groundwater pollution during construction and operation.

Notable and protected species

Bats

7.8.29 Based on existing data, there will be no loss of any bat roosts as a result of the Scheme. The two confirmed bat roosts of low conservation status are within residential properties adjacent to the Scheme. There is the potential for disturbance to bats using these roosts during the construction phase of the Scheme, however it is considered likely that any adverse impacts can be easily avoided by appropriate timing of the works and precautionary methods of working.

7.8.30 Whilst no bats were recorded roosting within the M2 viaduct structure, the number of survey visits fell below the standard guidance (Collins 2016) for a structure with moderate suitability for roosting bats. However, based on the suite of surveys undertaken to-date, it is considered unlikely that this structure would support anything more than low numbers of common species of bat, at most. As a precaution, consideration has been given to potential impacts on this structure with regard to bats, and mitigation has been designed on a precautionary basis, assuming the presence of low numbers of common and widespread species of bat. The mitigation is discussed further in Section 7.9.

7.8.31 Although an individual Bechstein's bat was recorded ('in the hand') 1.7 km from the Scheme, no Bechstien's bats have been recorded within the surveys carried out to date for the Scheme. The habitats within the Scheme offer limited suitable habitat for the species as there are limited mature broadleaved woodlands. The Ancient Woodland adjacent to the Scheme offers some potentially suitable habitat for this woodland specialist species, however, the area of Stockbury roundabout is subject to existing light levels, and there are limited interconnected habitats suitable to facilitate Bechstein's bats accessing wider landscape features surrounding the Scheme. Taking account of the above, it is considered unlikely that Bechstein's bats will utilise the Scheme habitat features.

7.8.32 At the time of the 2018 surveys for the M2 viaduct, the eastern half of the structure was subject to intense floodlighting due to a construction compound beneath the viaduct piers, therefore reducing the likelihood of a potential bat roost to be present within the viaduct structure. Additionally, the viaduct is approximately 260 m in length, with significant sections of the land beneath it unvegetated as it spans the A249 and Maidstone Road carriageways. Therefore, habitat connectivity for bats to cross the Scheme is very limited and connectivity to wider landscape features are constrained.

7.8.33 Construction of the Scheme would result in temporary disturbance to any bats using the structure, as a result of noise and vibration and increased lighting. Following construction, the A249 flyover will remain at its existing carriageway level beneath the M2 viaduct, and there will be a gradual increase in level of the flyover structure such that at 50 m from the viaduct, the height of the flyover will be at 2.5 m above existing level and at 150 m from the viaduct, the height of the flyover will be approx. 6.6 m above existing level. Therefore, no reduction in the gap between the viaduct structure and the A249 will occur. Additionally, the bridge to support the west bound slip road beneath the M2 viaduct will also be constructed at the same height as the existing A249 carriageway and therefore no reduction in the gap between the slip road and the viaduct structure will occur. As a result, any bats entering or exiting a roost on the underside of the viaduct would continue to have sufficient space available to do so. No modification or loss of roosting opportunities on the underside of this structure are therefore anticipated.

7.8.34 Works will be at least 30 m away from the two trees with high and moderate potential for supporting roosting bats. The existing buffering vegetation adjacent to these trees which extends along the M2 westbound off- and on-slip roads and comprises broad-leaved plantation woodland will also be retained. Therefore, no impacts to these trees are anticipated as a result of the Scheme, either during construction or operation.

7.8.35 The Scheme will involve temporary loss of foraging and commuting habitat, including relatively small sections of hedgerow adjacent to Amels Hill, Honeycrock Hill and Oad Street; loss of scrub adjacent to the A249; and loss of woodland adjacent to the A249 and existing slip roads with the M2. However, the habitat has been shown to be utilised by low numbers of common and widespread bat species, predominantly common pipistrelle and soprano pipistrelle, but with occasional brown long-eared and noctule recordings. Individual rarer bats were also recorded.

7.8.36 The Scheme will also result in loss of a small section of species poor hedgerow at Bowl Reed Farm access. Whilst no surveys for bats have been carried out at this small section of the Scheme, the nature conservation value of the habitat is considered to be of less than local value. Taking a precautionary approach based on the available information, the suitability of the hedge to support foraging bats is limited due to its lack of species diversity and young age, but it may provide a commuting route for small numbers of bats in the wider landscape surrounding the Scheme. Therefore, habitat creation measures to include planting trees no less than the current height of the existing hedgerow vegetation adjacent to the access entrance, to facilitate continued use of the hedgerow by commuting bats will be provided, following the broad principles of vegetated

'hop-overs' that are set out in Limpens (2005)[186]. There are alternative and more mature, interconnecting linear habitats within the landscape surrounding Bowl Reed Farm, which provide connectivity to foraging areas beyond the Scheme extent.

7.8.37 There are large areas of higher quality woodland and scrub habitat surrounding the Scheme and links to the wider landscape that are likely to support any foraging bats that are displaced temporarily until new woodland and scrub planting becomes established. Habitat creation will result in a permanent long-term increase in the total area of foraging habitat available to bats. In addition, the new planting will strengthen the linear vegetation features within the Scheme and improve connectivity to the wider landscape. This will be achieved by planting a linear belt of woodland parallel to the A249 which links Church Wood and the hedgerows along Honeycrock Hill, Amels Hill and Church Hill. The species-poor hedge adjacent to Church Hill will also be reinforced with a linear belt of trees and shrubs.

7.8.38 The removal of habitats adjacent to the road network and general construction activities are likely to result in temporary disturbance (noise, lighting and visual) to commuting and foraging bats during construction.

7.8.39 Although details pertaining to the current light levels are unknown, there are no lighting columns within the Scheme, except for on the approaches and exits associated with Stockbury roundabout. The proposed lighting scheme includes for improved lighting at the same locations. A narrow strip of the proposed woodland planting on the northwest side and southeast sides of the Stockbury roundabout will experience some light spill of between 1 and 5 Lux. However, this reduces to 0.2 Lux or below (similar to complete darkness[187]) within the vegetation moving away from the road. No further lighting for the Scheme is required. Whilst the Scheme has the potential to result in limited lighting disturbance in the Stockbury roundabout area, a dark corridor of vegetation will be maintained throughout the Scheme.

Hazel dormouse (dormouse)

7.8.40 Based on the surveys carried out, it has been assumed that dormice are present in all suitable habitats within the Scheme. As such, the Scheme will involve the temporary removal of vegetation that supports dormice. There are large areas of suitable woodland and scrub habitat surrounding the Scheme and links to the wider landscape (including Chestnut Wood and Church Wood) that are considered likely to support any dormice from within the Scheme area that will be displaced temporarily until new woodland or scrub planting becomes established.

7.8.41 Habitat creation will result in a permanent long-term increase in the total area of suitable foraging and nesting habitat available to dormice, with an additional 0.58 ha of woodland and 1.89 ha of scrub created.

7.8.42 The dormouse habitat within and adjacent to the Scheme is fragmented by existing roads, but it is not considered that the Scheme will exacerbate this fragmentation any further and dormice will be able to continue to move around

[186] Limpens HJGA, Twisk P & Veenbaas G (2005). Bats and road construction. Published by the Dutch Ministry of Transport, Public Works and Water Management Directorate General for Public Works and Water Management, Road and Hydraulic Engineering Institute, Delft, the Netherlands and the Association for the Study and Conservation of Mammals, Arnhem, the Netherland
187 ILP Guidance Note 08/18: Bats and artificial lighting in the UK, BCT & ILP, 2018

the landscape as they do currently. It is anticipated that the new planting will strengthen the linear vegetation features within the Scheme and improve connectivity to the wider landscape. This will be achieved by planting a linear belt of woodland parallel to the A249 which links Church Wood and the hedgerows along Honeycrock Hill, Amels Hill and Church Hill. The species-poor hedge adjacent to Church Hill will also be reinforced with a linear belt of trees and shrubs.

7.8.43 In the absence of mitigation, vegetation clearance and Scheme construction could result in incidental killing, injury or disturbance (noise, lighting and visual) to individuals and damage or destruction of nests (e.g. resting or breeding sites) during construction.

7.8.44 Although details pertaining to the current light levels are unknown, there are no lighting columns within the Scheme, except for on the approaches and exits associated with Stockbury roundabout. The proposed lighting scheme includes for improved lighting at the same locations. A narrow strip of the proposed woodland planting on the northwest side and southeast sides of the Stockbury roundabout will experience some light spill of between 1 and 5 Lux. However, this reduces to 0.2 Lux or below (similar to complete darkness[188]) within the vegetation moving away from the road. No further lighting for the Scheme is required. Whilst the Scheme has the potential to result in limited lighting disturbance in the Stockbury roundabout area, a dark corridor of vegetation will be maintained throughout the Scheme.

Breeding birds

7.8.45 The Scheme will involve the temporary removal of vegetation that could impact 17 notable bird species recorded during the breeding season. In the absence of mitigation this could involve potential killing, injury or disturbance or damage and destruction of active nests during construction of the Scheme. There are large areas of suitable habitat surrounding the Scheme and links to the wider landscape that are likely to support birds that are displaced temporarily until new woodland or scrub planting becomes established.

7.8.46 Approximately 12 ha of arable habitat will be permanently lost due to the Scheme. This habitat is considered to be of low value to notable breeding birds in its own right, due to disturbance resulting from the proximity to main roads and the lack of wide field verges and areas of set-a-side. During the breeding bird survey, this area was found to support very few territories of notable species associated with arable habitat (part of one skylark territory and one possible yellowhammer territory, for example).

7.8.47 Vegetation clearance and general construction activities are likely to result in temporary disturbance (i.e. noise/lighting/visual) to notable birds during construction. This could result in the displacement of notable birds due to an increase in visual and noise stimuli due to site clearance and construction activities.

7.8.48 Although details pertaining to the current light levels are unknown, there are no lighting columns within the Scheme, except for on the approaches and exits associated with Stockbury roundabout. The proposed lighting scheme includes

188 ILP Guidance Note 08/18: Bats and artificial lighting in the UK, BCT & ILP, 2018

improved lighting at the same locations. A narrow strip of the proposed woodland planting on the northwest side and southeast sides of the Stockbury roundabout will experience some light spill of between 1 and 5 Lux. However, this reduces to 0.2 Lux or below (similar to complete darkness[189]) within the vegetation moving away from the road. No further lighting for the Scheme is required. Whilst the Scheme has the potential to result in limited lighting disturbance in the Stockbury roundabout area, the majority of the Scheme will not experience any lighting impacts during operation.

7.8.49 Additional operational impacts may arise through disturbance to breeding birds from noise stimuli resulting from increased traffic flows. Noise modelling has predicted that the majority of sensitive receptors, i.e. 120 of 122 receptors within the study area[190] will be subject to a beneficial decrease, negligible (increase of 0.1-2.9 dB) or minor increase (3-4.9 dB) in daytime noise levels in the long-term operation of the Scheme. The modelling predicted that change in night-time noise levels at all receptors will be negligible[191].

Wintering birds

7.8.50 The Scheme will involve the temporary habitat loss that could impact 18 notable bird species recorded during the non-breeding season. In the absence of mitigation, this could involve the displacement of notable birds during construction. There are large areas of suitable habitat surrounding the Scheme and links to the wider landscape that are likely to provide foraging and loafing resources to support wintering birds that are displaced temporarily until replacement habitat becomes established.

7.8.51 Approximately 12 ha of arable habitat will be permanently lost due to the Scheme. This habitat is considered to be of low value to notable wintering birds in its own right, due to disturbance resulting from the proximity to main roads and the lack of wide field verges and areas of set-a-side. During the wintering bird survey, this area was found to support very few notable species associated with arable habitat (i.e. small flocks of common gull and black-headed gull and low numbers of skylark and meadow pipit).

7.8.52 Vegetation clearance and general construction activities are likely to result in temporary disturbance (i.e. noise/lighting/visual) to notable birds during construction. This could result in the displacement of notable birds due to an increase in visual and noise stimuli due to site clearance and construction activities. There are large areas of suitable habitat surrounding the Scheme and links to the wider landscape that are likely to provided foraging and loafing resources to support wintering birds that are displaced temporarily until replacement habitat becomes established.

7.8.53 Although details pertaining to the current light levels are unknown, there are no lighting columns within the Scheme, except for on the approaches and exits associated with Stockbury roundabout. The proposed lighting scheme includes improved lighting at the same locations. A narrow strip of the proposed woodland planting on the northwest side and southeast sides of the Stockbury roundabout

189 ILP Guidance Note 08/18: Bats and artificial lighting in the UK, BCT & ILP, 2018
190 The study area for the assessment of noise and vibration effects is defined in DMRB 213/11 as 600 m from the carriageway edge of any proposed new routes, existing routes to be bypassed or improved, or any other affected routes within 1 km of the Scheme.
191 Highways England (2019) Regional Investment Programme M2 Junction 5 Improvements Environmental Statement Volume 1 – Chapter 6 Noise and Vibration

will experience some light spill of between 1 and 5 Lux. However, this reduces to 0.2 Lux or below (similar to complete darkness) within the vegetation moving away from the road. No further lighting for the Scheme is required. Whilst the Scheme has the potential to result in limited lighting disturbance in the Stockbury roundabout area, the majority of the Scheme will not experience any lighting impacts during operation.

7.8.54 Additional operational impacts may arise through disturbance to wintering birds from noise stimuli resulting from increased traffic flows. Noise modelling has predicted that the majority of sensitive receptors, i.e. 120 of 122 receptors within the study area[190] will be subject to a beneficial decrease, negligible (increase of 0.1-2.9 dB) or minor increase (3-4.9 dB) in daytime noise levels in the long-term operation of the Scheme. The modelling predicted that change in night-time noise levels at all receptors will be negligible[191].

Reptiles

7.8.55 The Scheme will involve the temporary removal of vegetation that supports common reptile species (slow-worm, common lizard and possibly adder). In the absence of mitigation there is the potential to incidentally kill or injure reptiles during construction. There are large areas of suitable habitat surrounding the Scheme and links to the wider landscape that are likely to support any reptiles that are displaced temporarily until newly planted habitats become established.

7.8.56 Habitat creation will result in a permanent long-term increase in the total area of suitable reptile habitat available, with an additional 1.89 ha of scrub and 5.33 ha of grassland habitats created.

Non-native invasive plant species

7.8.57 In the absence of mitigation, the Scheme has potential to result in the spread of cotoneaster during construction.

7.9 Design, mitigation and enhancement measures

7.9.1 The avoidance, mitigation and compensation measures outlined below have been, or will be, incorporated into the detailed design of the Scheme to avoid and reduce the significance of any adverse impacts on valued nature conservation receptors. The measures outlined below have been agreed with Natural England as part of the consultation process for this assessment. The preliminary environmental design plan prepared to outline the mitigation design for the Scheme is provided on Figure 2.3 in Volume 3.

Avoidance of habitat loss

7.9.2 The Scheme has been designed to avoid the loss of Ancient Woodland and veteran trees. Loss of other habitats has been minimised as far as possible throughout the Preliminary Design Stage. This is evidenced, for example, by the limited extent of widening at Oad Street to enable safe traffic movement associated with the junction of Oad Street and A249. This resulted in reducing the impacts to important hedgerows along Oad Street. The design and alignment of slope works associated with the M2 west bound off-slip was redesigned and drainage design amended to avoid impacts to Ancient Woodland and nearby veteran trees.

Habitat creation and translocation

7.9.3 Where habitat loss could not be avoided, habitat creation and/or translocation will be undertaken. This is included under specific measures detailed in Table 7.9 below and Figure 7.3 in Volume 3.

7.9.4 The provision of pre-construction mitigation measures will take place from September 2019 onwards, throughout the winter months, before start of construction in spring 2020. This is taken account of in the details of mitigation provided in Table 7.9 below. The provision of mitigation details includes dates relevant to each activity and those dates are based on the Buildability Construction Programme provided in the OEMP (Appendix A in Volume 2). Should the programme change, subsequent amendments to the timing for mitigation will be required.

Provision of an OEMP

7.9.5 To avoid accidental encroachment on locally designated sites, minimise habitat damage and minimise loss and disturbance of notable and legally protected species during construction, good practice methodologies, including an Outline Environmental Management Plan (OEMP) in Appendix A in Volume 2, will be adopted for all construction operations. The OEMP includes the following measures:

- Protection of designated sites, and other notable retained habitats as far as possible outside the working area from accidental incursion by the use of construction exclusion fencing;
- Protection of designated sites, notable habitats, and notable and legally protected species outside the working area from pollution during all clearance and construction works by adherence to the Pollution Prevention for Businesses guidance[192] and the Construction Industry Research and Information Association (CIRIA) guidance on the control of water pollution from construction sites[193];
- Protection of retained trees following standard practice (i.e. BS 5837:2012 Trees in relation to design, demolition and construction. – Recommendations);
- Use of mitigation measures under licence if habitats or features afforded legal protection due to their use by protected species (e.g. dormice) would be affected during the works;
- Use of precautionary methods of working during construction to minimise risks to individual animals of protected species where licences would not be required, such as timing works to avoid sensitive seasons (e.g. breeding bird season);
- Provision of an Ecological Clerk of Works (ECoW) to advise on the above

[192] Guidance for Pollution Prevention for Business, Defra and EA, published July 2016. https://www.gov.uk/guidance/pollution-prevention-for-businesses#construction-inspection-and-maintenance
[193] The CIRIA documents are a series of publications developed by the Construction Industry Research and Information Association. Each document is targeted at a particular type of business or activity and covers environmental good practice to minimise pollution. and CIRIA C715 Environmental good practice on site handbook). The CIRIA publications also make reference to environmental legal obligations and are available from: http://www.ciria.org/CIRIA/Resources/Resource_overview/Resources/Resources_overview.aspx?hkey=a80608d2-a045-4d72-8bb9-5ecf23f8d761".

measures during construction; and

- Mitigation measures implemented as set out in Chapters 5 Air Quality, 6 Noise and Vibration, and 8 Road Drainage and the Water Environment to avoid and reduce the significance of any potential effects caused by air, noise and water pollution during construction and operation.

7.9.6 The measures outlined above will be reviewed and updated as required during detailed design stage and used to inform the Construction Environmental Management Plan (CEMP) that will be prepared by the principal contractor.

7.9.7 Specific mitigation measures are provided below, in Table 7.9, and shown on Figure 7.3 in Volume 3. Advanced planting detailed in the sections below refers to planting that will be undertaken once land beyond Highways England ownership is acquired. This process is anticipated to be complete by September 2019. Some areas of habitat required to be created or translocated as part of the mitigation measures will be possible prior to start of works commencing (anticipated to be spring 2020). Due to complications with Scheme build methods, some areas of habitat creation and mitigation measures will be required during or post construction. Further details regarding the timings of habitat creation and mitigation are provided in the OEMP in Appendix A in Volume 2.

Specific measures to protect designated sites, Ancient Woodland and trees

7.9.8 The location of access tracks, site compound and material storage areas will be sited outside designated sites and Ancient Woodland, away from retained trees and outside of notable habitats as far as possible, and a buffer zone[194] will be implemented around these receptors where works are not limited by the existing carriageway. Advanced woodland planting adjacent to Church Wood will supplement the existing buffering vegetation and ensure that the integrity of this area of Ancient Woodland is maintained throughout the construction period.

Specific measures to mitigate and compensate for loss of habitats within designated sites (Church Hill, Stockbury RNR and Honeycrock Hill RNR)

7.9.9 Where there is permanent or temporary loss of grassland habitats within the two RNRs, this will be kept to a minimum as far as practicable.

7.9.10 A total of 2.8 ha of chalk grassland will be created along the A249 between Church Hill and Honeycrock Hill and along the A249 to the east of the M2 with approximately 0.2 ha being created between September and December 2019 and prior to of start of works in spring 2020.

7.9.11 To facilitate detailed identification of the extent of orchid locations within the RNR's, pre-construction surveys will be carried out during the preceding flowering season before construction to mark the locations of orchid colonies that will require translocation.

[194] For designated sites and Ancient Woodland, a buffer zone of at least 15 m will be used where practicable. For retained trees, root protection zones will be advised by an arboriculturalist prior to works commencing.

7.9.12 Grassland turfs containing orchid colonies will be translocated to new habitat creation areas assigned for chalk grassland immediately after they have been cut and appropriate preparations have been made to the receptor areas[195]. Preparations will include matching the characteristics of the receptor area to those of the donor site in terms of aspect, slope, soil characteristics (especially pH and nutrients) and hydrology. The indicative locations for the receptor areas are shown on Figure 7.3 Mitigation Plan in Volume 3 and will be situated as close to the donor areas as is reasonably practicable. The exact location of the receptor areas will be determined following the results of the soil sampling survey and an assessment of the soil characteristics, aspect, orientation, etc., to establish the suitability of the receptor areas for translocation and will be provided during Detailed Design.

7.9.13 Where possible, the grassland turfs to be translocated will be moved in the autumn when soils are warm and moist and new root growth is possible before winter.

7.9.14 In addition, the same method of receptor site preparation will be employed for all grassland habitats within the affected areas of the RNRs to facilitate the establishment of new habitat creation areas.

Specific measures to mitigate and compensate for loss of hedgerows and other habitats

7.9.15 Hedgerows assessed as 'important' and that will be subject to impacts will be translocated, in particular a section of the hedgerow along Oad Street (approximately 194 m), a section of the hedgerow at the Scheme junction with Honeycrock Hill (approximately 137 m), and the same for Amel's Hill (approximately 52 m). Such measures will provide continued function as commuting corridors for bats (and other species).

7.9.16 Advance planting of woodland and scrub prior to works commencing in spring 2020 will be undertaken in areas along the A249 between Church Hill and Church Wood, along the new Maidstone Road link, Oad Street and in the northwest section on the east side of the M2, which will mitigate for temporary habitat clearance during construction by reducing time taken for new habitat to mature and enable continued movement of protected species through suitable habitat.

7.9.17 Habitat creation will result in the establishment of approximately 6.09 ha of native woodland, 10 ha grassland (including semi-improved calcareous grassland, and amenity grassland), 2.63 ha scrub, 3777 m native hedgerow, and an extra 50 m^2 of pond replacement, which will ultimately contribute to an overall increase in the total area of ecologically valuable terrestrial and aquatic habitats; with the exception of the pond, which although will be smaller in area, will include for a planting scheme and habitat creation that will improve on the habitat quality currently evidenced for the existing pond.

7.9.18 Of the habitats to be created, advance planting prior to works commencing will include 3.13 ha of woodland and scrub and 665 m of native hedgerow.

[195] Receptor site preparation and translocation will take account of current guidance (including 'Habitat translocation – a best practice guide' (CIRIA C600, 2003),

7.9.19 All trees to be retained within or adjacent to the working area will be protected in accordance with BS5837:2012.

7.9.20 Dead wood will be taken from felled trees on-site and re-used to establish reptile refugia and invertebrate habitat comprising 10 above ground refugia in newly created habitats, as appropriate.

7.9.21 Prior to commencement of construction, a Habitat Management Plan and Landscape and Ecology Management Plan will be produced by the Design Contractor/Principal Contractor and implemented to provide for the successful establishment of newly created habitats and to manage landscape and ecological features within the mitigation design. Outline details are provided in the OEMP (Appendix A in Volume 2).

Specific measures to mitigate loss of pyramidal and bee orchid colonies

7.9.22 To enable species diversity within areas of newly created species rich grassland, pyramidal and bee orchids will be translocated within the Scheme extent. As detailed above, to facilitate detailed identification of the extent of orchid locations within the Scheme, pre-construction surveys will be carried out during the preceding flowering season prior to construction to mark the locations of orchid colonies that will require translocation.

7.9.23 Grassland turfs containing orchid colonies from within the Scheme extent (in addition to those within the RNR's) will be translocated to new habitat creation areas assigned for species-rich grassland. The indicative locations for the receptor areas are shown on Figure 7.3 Mitigation Plan in Volume 3 and will be situated as close to the donor areas as is reasonably practicable. The exact location of the receptor areas will be determined following the soil sampling survey to establish receptor area suitability for translocation.

Specific measures to protect bats/potential bat roosts

7.9.24 The two confirmed bat roosts of low conservation status are within residential properties adjacent to the Scheme. Works will be designed to avoid disturbance to bats using these roosts during the construction phase of the Scheme, through for example, appropriate timing of the works and precautionary methods of working. If this isn't possible, then further surveys and a Natural England European Protected Species Mitigation (EPSM) licence will be required.

7.9.25 No evidence of roosting bats has been recorded within the viaduct structure but there were some survey uncertainties and it is considered possible that the viaduct could be used by small numbers of common bat species. As a precaution, mitigation has been designed assuming the presence of low numbers of common species of bat that may experience temporary disturbance as a result of noise, vibration and increased lighting during construction. To negate potential impacts to bats, should they be confirmed as present within the structure, sensitive lighting design will be prepared for works around the viaduct and will include downward facing lighting to make sure direct illumination of the underside of the viaduct is avoided.

7.9.26 A pre-construction dusk emergence survey will be undertaken to confirm the presence or likely absence of roosting bats and, in the event that bats are

present and based on a further, more detailed impact assessment, a Natural England EPSM licence may be required. Eight numbered bat boxes will be installed on top of poles (two boxes per pole) to provide roost opportunities similar to those within the viaduct structure within suitable nearby retained habitats and within created habitats as part of the Scheme.

7.9.27 One tree with low bat roost potential requires removal (T4). This tree should be felled in a precautionary manner using soft felling techniques (where tree limbs are cut and left grounded over night to allow any bats to make their way out) in line with Bat Conservation Trust (BCT) guidance[196] .

Specific measures to protect foraging and commuting bats

7.9.28 New hedgerow and woodland planting will enhance commuting and foraging opportunities for bats. Planting locations are strategically located to improve connectivity to the wider landscape, including along the Maidstone Link Road and the A249 (see the Preliminary Environmental Design on Figure 2.3 in Volume 3).

7.9.29 Translocation of hedgerows will ensure that this resource is not lost and reduce the time taken until full establishment.

7.9.30 Advance woodland planting will be provided prior to commencement of construction works to reduce impacts from temporary loss of foraging habitat.

7.9.31 Bat boxes will be installed within Highways England owned land and within suitably vegetated locations within the Scheme to provide additional roost opportunities to further enhance the suitability of habitats within the Scheme to support bats.

7.9.32 Night working will be avoided where possible and any lighting required for construction will be designed sensitively to avoid illuminating confirmed bat roosts in proximity to the Scheme and boundary features used by commuting/foraging bats such as woodland, hedgerows and scrub edge.

7.9.33 New road lighting has been designed to minimise light spill as far as possible taking into consideration the presence of commuting and/or foraging bats and other wildlife, including measures to avoid and/or minimise light spill onto adjacent vegetation, including Ancient Woodland and veteran trees. As a result, a dark corridor of vegetation will be maintained throughout the Scheme.

Specific measures to protect dormice

7.9.34 All clearance of dormouse habitat will be carried out using where appropriate a combination of a Precautionary Method of Working (PMW) and Natural England European Protected Species Mitigation (EPSM) licence for dormice. Tasks carried out will be to facilitate advance mitigation measures prior to construction works commencing. The licence will be submitted as soon as land acquisition is confirmed (anticipated to be September 2019). Taking account of the time required for a licence application for works relating to dormice, it is anticipated that the PMW will be adopted initially for vegetation clearance works and the

[196] Bat and Trees, Bat Conservation Trust, January 2018

licensable works will be carried out thereafter, in October 2019. Both documents will be prepared in advance of the advance mitigation measures commencing.

7.9.35 Brash piles in linear form, providing connectivity between suitable retained habitats for dormice will be created prior to construction works commencing (see Figure 7.3 in Volume 3 for further detail.

7.9.36 Dormouse nest boxes (a minimum of 30 boxes) will be installed in adjacent retained woodland/scrub (within land owned by Highways England) prior to vegetation clearance to mitigate for temporary woodland habitat loss (and provide a long-term enhancement). The exact number and location of the nest boxes will be agreed with Natural England as part of the EPSM licence application.

7.9.37 Vegetation clearance will take place in the presence of a licensed ecologist. The methods and timing of vegetation clearance will be set out in the PMW and in the licence method statement.

7.9.38 There will be habitat creation, including approximately 8.6 ha of woodland and scrub to compensate for habitat lost and provide a long-term enhancement by increasing the total area of habitat available for dormice and improved habitat connectivity for dormice, particularly between Church Wood and the surrounding hedgerows.

7.9.39 Post-construction monitoring of the dormouse population will be undertaken in accordance with the Method Statement that will form part of the licence application, which will be agreed with Natural England.

Specific measures to protect breeding birds

7.9.40 Vegetation clearance will take place from September to February, as far as possible, to prevent risk of harm to breeding birds and their nests during the works. If vegetation clearance is required during the core breeding season (March-August inclusive), the area to be cleared will be inspected by an ecologist for the presence of nesting birds. This will be up to 24 hours prior to it being cleared to minimise opportunities for nest building between the survey and the start of works. Any nest in use or being built during inspection will be left undamaged with an appropriate buffer of surrounding vegetation for the entire nesting period and alternative approaches to the works will be proposed.

7.9.41 Nest boxes for birds (32 in total) will be installed within suitably vegetated locations within the Scheme to provide additional nesting opportunities to further enhance the suitability of habitats within the Scheme to support breeding birds.

7.9.42 Night working will be avoided where possible and any lighting required for construction will be designed sensitively to avoid illuminating features used by roosting birds such as hedgerows and woodland/scrub edge.

7.9.43 Good working practices will be employed in order to minimise noise impacts during construction and operation. This includes fitting all vehicles, plant and tools with silencers and/or mufflers, and installing temporary noise barriers or other noise containment measures to minimise construction noise levels where possible. Low noise road surfacing on the A249 will be used in order to reduce noise levels during the operation of the Scheme.

Specific measures to protect reptiles

7.9.44 Habitat creation for reptiles will be undertaken, comprising grassland and scrub, and provision of natural refugia/habitat piles within retained and newly created habitat areas. The provision of brash piles and ten above ground refugia will be provided in advance of commencement of construction works during vegetation clearance to allow reptiles to be displaced or relocated into suitable established habitat.

7.9.45 Vegetation clearance will take place under a PMW with guidance from an on-site ecologist, using a two-stage cut to persuade reptiles away from the working area.

Specific measures to protect badgers

7.9.46 As a precaution, a pre-construction badger survey will be undertaken to confirm the continued absence of badger setts from within and adjacent to the Scheme boundary.

7.9.47 No protective fencing of existing badger setts are considered necessary as known setts are located beyond 50 m from the carriageway and works area. Construction traffic will be limited to the existing carriageways and the Scheme extent.

7.9.48 All excavations will be covered or closed overnight to prevent any animals becoming trapped. Alternatively, a ‘ramp’ or graded edge will be provided as a means of escape.

Potential presence of invasive plants

7.9.49 A pre-construction survey for non-native invasive species will be carried out. Should such species be identified, suitable mitigation measures will be incorporated into the OEMP and CEMP.

Specific measures to protect wintering birds

7.9.50 Night working will be avoided, where possible, and any lighting required for construction will be designed sensitively to avoid illuminating adjacent features used by roosting birds such as hedgerows, woodland/scrub edge and arable fields.

7.9.51 Good working practices will be employed in order to minimise noise impacts during construction and operation. This includes fitting all vehicles, plant and tools with silencers and/or mufflers, and installing temporary noise barriers or other noise containment measures to minimise construction noise levels where possible. Low noise road surfacing on the A249 will be used in order to reduce noise levels during the operation of the Scheme.

General Mitigation Measures

7.9.52 All excavations will be covered or closed overnight to prevent any animals (i.e. badgers) becoming trapped. Alternatively, a ‘ramp’ or graded edge will be provided as a means of escape.

Table 7.9: Mitigation schedule

ID	Activity	Responsible party	Where	Timing	What guidance	Receptor site preparation	Further detail	Land requirements
1	Preparation of EPSM licence application for dormice	Highways England / Contractor	Scheme wide (to take account of suitable habitat for dormice to be impacted).	Preparation - August 2019 Licence submission – early September 2019 Application is required up to three months prior to vegetation clearance as NE require 40 working days to determine the application. Licensable works (including vegetation clearance) – from October 2019 upon receipt of licence.	Dormouse Conservation Handbook (English Nature 2012).	A minimum of 30 dormouse nest boxes will be installed in retained habitat to provide refuge for any dormice that could be displaced by advance vegetation clearance. However, up to 50 dormouse nest boxes could be installed based on putting boxes up in the retained habitats at 20 m spacing. Additional dormouse nest boxes will be installed following construction and as agreed with NE under licence agreement.	Details of post-construction monitoring will be provided in line with the Method Statement forming part of the EPSM licence.	Land to be acquired and habitat measures prior to and during construction to take place.

ID	Activity	Responsible party	Where	Timing	What guidance	Receptor site preparation	Further detail	Land requirements
2	Pre-construction bat emergence survey of M2 viaduct	Highways England / Contractor	M2 viaduct.	Survey to take place between May and August 2019.	BCT (2016).	N/A	As agreed with Natural England, an emergence survey in summer months to inform whether EPSM licence is required for potential disturbance to the viaduct structure during construction.	Agreed access to the M2 beneath viaduct structure and all necessary health and safety methods of working prepared in advance.
3	Preparation of EPSM licence application for bats (if required)	Highways England / Contractor	M2 viaduct (if required).	Licence submission – September 2019. Licensable works – October 2019.	Bat Mitigation Guidelines (EN, 2004) Bat Surveys for Professional Ecologists (BCT, 2016).	N/A	Should a licence be required, it is anticipated to be for potential disturbance to a low conservation status roost identified in the viaduct, following additional survey.	Land to be acquired and habitat measures prior to and during construction to take place.
4	Chalk grassland creation	Highways England / Contractor	Along the A249 between Church Hill and Honeycrock Hill and along the A249 to the east of the M2.	Pre-construction survey – May to July 2019. In planting season – Autumn (Sept-Oct) 2019 or Spring (Feb-March) 2020.	CIRIA Guidelines C600 (2003) Series 3000 Specification which draws on guidance from DMRB Vol. 10, Section 1, Part 2 - HA 56/92.	Survey required to ensure receptor site has the right conditions for chalk grassland to establish or appropriate preparations will be made to the receptor areas, (including matching the characteristics of the receptor area to those of the donor site in terms of aspect, slope, soil	A total of 2.86 ha of chalk grassland will be created (through seeding) along the A249 between Church Hill and Honeycrock Hill (see Figure 7.3 in Volume 3).	Land to be acquired and restored to chalk grassland on completion of works.

ID	Activity	Responsible party	Where	Timing	What guidance	Receptor site preparation	Further detail	Land requirements
						characteristics and hydrology).		
5	Translocation of 0.23 ha grassland turfs with orchids pre-construction (Church Hill, Stockbury RNR and Honeycrock Hill RNR)	Highways England/ Contractor	From RNRs (see Figure 7.3 in Volume 3) to areas of chalk grassland (as above).	Pre-construction survey – May to July 2019. In autumn/early winter (Sept – Nov) 2019. Assuming preparation of receptor site in advance, in September 2019.	CIRIA Guidelines C600 (2003) Series 3000 Specification which draws on guidance from DMRB Vol. 10, Section 1, Part 2 - HA 56/92.	Survey required to ensure receptor site has the right conditions for chalk grassland to establish or appropriate preparations will be made to the receptor areas.	The 0.23 ha of grassland turfs with orchids will be translocated to an area designated for chalk grassland creation along the A249 adjacent to Honeycrock Hill (see Figure 7.3 in Volume 3).	Land acquired and prepared for translocation immediately (this area is not required for any works).
6	Pre-construction orchid survey of Scheme (including RNR's)	Highways England/ Contractor	Across the Scheme.	Pre-construction survey – May to July 2019.	CIRIA Guidelines C600 (2003).	N/A	Survey required to identify and mark locations where orchids are required to be translocated.	Access to the highway verges will be required prior to the survey taking place and all necessary health and safety methods of working prepared in advance.
7	Translocation of grassland turfs containing the orchid colonies during construction (as identified by pre-construction	Highways England/ Contractor	From various areas across the Scheme that will be defined more specifically once pre-construction survey is carried out.	In autumn/early winter (Sept – Nov) 2019. Assuming preparation of receptor site in advance in September 2019.	CIRIA Guidelines C600 (2003).	Survey required to ensure receptor site has the right conditions for chalk grassland to establish or appropriate preparations will be made to the receptor areas.	Assuming that receptor site conditions can be met, grassland turfs will be translocated to areas designated for chalk grassland along the A249 between Church Hill and Honeycrock Hill (see Figure 7.3 in Volume 3).	Land to be acquired and restored to chalk grassland on completion of works.

ID	Activity	Responsible party	Where	Timing	What guidance	Receptor site preparation	Further detail	Land requirements
	survey) from within the Scheme extent but outside of the RNR's							
8	Pre-construction Phase 1 survey of Bowl Reed Farm access	Highways England/ Contractor	Bowl Reed Farm access.	Pre-construction survey – May to July 2019.	JNCC (2010) & CIEEM (2017).	N/A	Survey required to identify any further ecological constraints in Bowl Reed Farm access area.	Access to the highway verges will be required prior to the survey taking place and all necessary health and safety methods of working prepared in advance.
9	Pre-construction non-native species survey of Scheme extent	Highways England/ Contractor	Across the Scheme.	Pre-construction survey – May to July 2019.	JNCC (2010) & CIEEM (2017).	N/A	Survey required to identify any non-native plant species within the Scheme extent to inform appropriate management/ mitigation during construction.	Access to the highway verges will be required prior to the survey taking place and all necessary health and safety methods of working prepared in advance.
10	Pre-construction badger survey of Scheme extent (incl. Bowl Reed Farm access)	Highways England/ Contractor	Across the Scheme.	Pre-construction survey – May to July 2019.	Harris, C., et al (1989) Surveying Badgers, Mammal Society. & CIEEM (April, 2013) Competencies	N/A	Survey required to identify any new evidence of badgers within the Scheme extent to inform appropriate mitigation measures (which may include the requirement for a licence from NE).	Access to the highway verges will be required prior to the survey taking place and all necessary health and safety methods of working prepared in advance.

ID	Activity	Responsible party	Where	Timing	What guidance	Receptor site preparation	Further detail	Land requirements
					for Species Survey: Badger.			
11	Pre-construction planting of woodland, scrub and hedgerow	Highways England/ Contractor	Along the A249 between Church Hill and Church Wood; along the new Maidstone Road link; Oad Street; and in the northwest section along the east side of the M2.	In planting season Autumn (Sept-Nov) 2019 or Spring (March-May) 2020. Pre-construction.	Series 3000 Specification which draws on guidance from DMRB Vol. 10, Section 1, Part 2 - HA 56/92.	N/A	3.13 ha of woodland and scrub and 665 m of native hedgerow.	Land will be acquired and planted as soon as available pre/during construction.
12	Habitat creation during and post-construction to compensate for loss of habitat (including native woodland, scrub, species-rich grassland, native hedgerows, dry ditch and a pond)	Highways England/ Contractor	Remaining areas on plan (see Figure 7.3 in Volume 3).	In planting season Autumn (Sept-Nov) 2020 or 2021 or Spring (March-May) 2021. During/post construction.	Series 3000 Specification which draws on guidance from DMRB Vol. 10, Section 1, Part 2 - HA 56/92.	N/A	Habitat creation during/post-construction will involve establishment of a total of approximately 2.96 ha of native broadleaved woodland (W8 NVC classification), 7.37 ha of other grassland including tall ruderal (CG3,CG4 or CG5 NVC classification[197]), as well as amenity grassland , 2.63 ha scrub, 3112 m native hedgerow, 3266 m of dry ditch and 50 m^2 of pond replacement.	Land will be acquired.

[197] The species composition for habitat types to be created will be refined following ground investigations during detailed design stage.

ID	Activity	Responsible party	Where	Timing	What guidance	Receptor site preparation	Further detail	Land requirements
13	Translocation of hedgerows	Highways England/ Contractor	Hedgerows along Oad Street, Amels Hill (both sides) and Honeycrock Hill (both sides).	In autumn/early winter (Sept– Dec) 2019. Pre/during construction.	CIRIA Guidelines C600 (2003) Box, J. and Stanhope, K. (2010). Translocation of wildlife habitats: a guide for civil engineers. Civil Engineering, 163: 123-130.	Receptor site must match the donor site adequately. A survey is required to survey the soil types, water relation/hydrology, aspect/slope etc of the donor and receptor site.	307m to be translocated. Hedgerow relocated 3 m to the north of existing alignment on Oad Street.	Land to be acquired.
14	Brash pile (or 'dead hedge') creation to support dormice, bats and reptiles within the Scheme	Highways England/ Contractor	Along linear boundaries of the site where habitat connectivity is required between retained habitats and will include, along the A249 between Church Hill and Church Wood, along Maidstone Road and in the northwest section on the east side of the M2 (see Figure 7.3 in Volume 3).	During vegetation clearance or using vegetation cleared from habitat management areas (Woodlands near scheme) prior to main construction works (September / October 2019, or earlier, if licence obtained).	Amphibian and Reptile Groups of the United Kingdom (ARG UK), (2018). Advice Note 11. Dormouse Conservation Handbook (2006).	N/A	The length of brash piles ('dead hedges') extends approximately 1500 m and will be predominantly along the western boundary of the A249, to the north and to the south of the M2 carriageway.	Land to be acquired.

ID	Activity	Responsible party	Where	Timing	What guidance	Receptor site preparation	Further detail	Land requirements
15	Habitat manipulation and provision of habitat piles within retained and newly created habitat areas to support reptiles	Highways England/ Contractor	Where habitat connectivity is required between retained habitats and will include, along the A249 between Church Hill and Church Wood, along Maidstone Road and in the northwest section on the east side of the M2 See Figure 7.3 in Volume 3.	Habitat manipulation measures – April to September, when reptiles are active (August/ September 2019). Habitat pile creation - during vegetation clearance (September / October 2019) or habitat management (March 2022 onwards).	GCN mitigation guidelines (2001) for design of hibernacula ARG UK (2018) Advice Note 11.	Pre-defined areas will be marked out where suitable, before habitat manipulation and creation of habitat piles for reptiles.	Survey required to assess suitability of adjacent habitats where reptiles can move to and to inform where habitat manipulation and/or creation of habitat piles will be of most value within the defined areas.	Land to be acquired and land owned by Highways England.
16	Habitat management in retained vegetation areas to enhance suitability for protected / notable species	Highways England/ Contractor	In woodlands near the Scheme, owned by HE.	Prior to main works, in September/ October 2019 to avoid the nesting bird season (March to August) and whilst reptiles are active (March to September/October depending on prevailing weather conditions).	Precautionary Method of Working in relation to dormice, nesting birds and reptiles.	N/A	Arisings from habitat management works (including tree thinning) will be used for reptile refugia and brash piles (or dead hedges).	Land owned by Highways England.
17	Soft felling of T4 tree with low bat roost potential	Highways England/ Contractor	Near the junction of Oad Street and A249 (see Figure 7.3 in Volume 3).	September 2019 (whilst bats remain active, and before they enter hibernation).	Bat Mitigation Guidelines (EN, 2004). Bat Surveys for Professional	N/A	If bats or evidence of a roost is found at any point, measures to protect individual bats and maintain roosting opportunities will	Land to be acquired.

ID	Activity	Responsible party	Where	Timing	What guidance	Receptor site preparation	Further detail	Land requirements
					Ecologists (BCT, 2016).		be put in place including, if required, measures under an EPSM licence.	
18	Site wide vegetation clearance	Highways England/ Contractor	Within areas subject to initial clearance, to facilitate pre-construction mitigation and subsequently across all other areas of the site except where retained habitats are to be maintained. See Figure 7.3 in Volume 3.	Between September 2019 to February 2020 to avoid nesting birds	Precautionary Method of Working in relation to dormice, nesting birds and reptiles.	N/A	Vegetation clearance can be undertaken during summer months. However, a precautionary method of working is required along with ecological watching brief to avoid impacts to nesting birds.	Land to be acquired.
19	Installation of dormouse nest boxes as part of the pre-construction works. and post construction	Highways England/ Contractor	In existing and retained woodland owned by HE and in habitat creation areas post construction. See Figure 7.3 in Volume 3.	October 2019 when dormice still active and prior to vegetation clearance. Post construction: boxes will be installed between November 2021 and February 2022, before dormice emerge from hibernation.	In line with EPSM licence documents.	N/A	A minimum of 30 dormouse nest boxes will be installed in retained habitat to provide refuge for any dormice that could be displaced by advance vegetation clearance. However, up to 50 dormouse nest boxes could be installed based on putting boxes up in the retained habitats at 20 m spacing. Additional nest boxes will be installed following construction and as agreed	Land owned by Highways Engalnd.

ID	Activity	Responsible party	Where	Timing	What guidance	Receptor site preparation	Further detail	Land requirements
							with NE under licence agreement. Indication of areas where nest boxes will be installed is provided in Figure 7.3 in Volume 3, and will be detailed in EPSM licence documents.	
20	Installation of Bird nest boxes	Highways England/ Contractor	In existing and retained woodland owned by HE and in habitat creation areas post construction.	Between September 2021 to February 2022 to avoid potential disturbance to nesting birds.	Nest boxes should be erected at least two metres above ground level, out of direct sunlight and facing between north and east to avoid the wettest winds. They should be located away from any bird feeders and other nest sites, and close to vegetation.	N/A	A total of 32 bird nest boxes of various design to be installed to accommodate bird species identified during the surveys and which may lose nesting sites as a result of the Scheme. Nest boxes to be fixed in line with manufacturers details.	Land owned by Highways England and Land to be acquired.
21	Installation of Bat boxes	Highways England/ Contractor	On top of poles to provide roost opportunities similar to those within the viaduct structure.	Prior to and during construction (September 2019 / February 2022).	Bat Mitigation Guidelines (EN, 2004). Bat Surveys for Professional Ecologists (BCT, 2016).	N/A	A total of 8 bat boxes to be installed pre- construction on poles. Two bat boxes will be fitted onto each pole (4 poles). A further 4 bat boxes will be installed post-construction in areas of habitat to	Land owned by Highways England and Land to be acquired.

ID	Activity	Responsible party	Where	Timing	What guidance	Receptor site preparation	Further detail	Land requirements
			Also, within suitable nearby retained habitats.				provide additional roosting opportunities for bats. All bat boxes installed should be suitable to support the bat species identified during the surveys. Bat boxes to be fitted to the poles in line with manufacturers details.	

7.10 Assessment of effects

7.10.1 Table 7.10 below provides an assessment of the construction and operational impacts and subsequent effects (both positive and negative) of the Scheme on important ecological features within the final EZoI of the Scheme. The assessment takes account of all mitigation measures to be included in the Scheme.

Table 7.10: Assessment of impacts and effects from construction and operation of the Scheme

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
North Downs Woodlands SAC	International/ European	Construction: No impacts	None	None	Neutral
		Operation: Potential for adverse impacts to habitat quality from reduction in air quality.	None (HRA concluded no likely significant effects)	None (HRA concluded no likely significant effects)	Neutral
Wouldham to Detling Escarpment SSSI	National	Construction: No impacts	None	None	Neutral
		Operation: Potential for adverse impacts to habitat quality from reduction in air quality.	None (HRA concluded no likely significant effects)	None (HRA concluded no likely significant effects)	Neutral
Queendown Warren SSSI	National	Construction: No impacts	None	None	Neutral
		Operation: Potential for adverse impacts to habitat quality from reduction in air quality.	Following the air quality assessment, NOx concentrations are not anticipated to appreciably increase such that there would be any adverse impacts on the designated site as a result of the Scheme.	None	Neutral
Honeycrock Hill (MA04) RNR and associated semi-	County	Construction:	Translocation of habitats and specific species which would otherwise be lost. Additional areas	Loss of calcareous grassland (0.08 ha) will be replaced by 2.86 ha of translocated and newly created habitat. The mitigation that	Slight adverse

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
improved calcareous grassland		Direct habitat loss of 0.07 ha of designated site. Potential for indirect adverse impacts to retained habitat adjacent to the Scheme boundary as a result of pollution.	of chalk grassland (2.8 ha) will also be created in the vicinity of the existing RNRs. Approximately 0.2 ha will be created in advance, prior to construction works commencing. A methodology for establishment of, and a long-term management plan for chalk grasslands will be prepared and implemented. Retained areas of designated site to be protected from incursion and pollution prevention measures will be implemented during construction of the Scheme.	includes translocation will initially establish in 1 – 2 years following translocation and will require further time to settle and fully establish, as well as ongoing management thereafter. The grassland that is to be newly created will take some time to establish (approximately 10year) and will require ongoing management. Temporary displacement of species supported by the designated site (i.e. reptiles) may occur in the interim due to the temporary loss of habitat available. However, there will be retained habitat adjacent to the Scheme which links to the wider area which could support any displaced individuals in the short-term while translocated habitat establishes. Taking account of the limited temporary loss of habitat, and the provision of additional habitat to that which is lost, the Scheme could result in temporary slight adverse effects on this designated site.	
		Operation: None	None	None	Neutral
Church Hill, Stockbury (MA11) RNR and associated semi-improved calcareous grassland	County	Construction: Direct habitat loss of 0.15 ha of designated site. Potential for indirect adverse impacts to retained habitat adjacent to the	Translocation of habitats and specific species which would otherwise be lost. Additional areas of chalk grassland (2.86 ha) will also be created in the vicinity of the existing RNRs. A methodology for establishment of, and a long-term management	Loss of calcareous grassland (0.15 ha) will be replaced by 2.86 ha of translocated and newly created habitat. The mitigation that includes translocation will initially establish in 1 – 2 years following translocation and will require further time to settle and fully establish, as well as ongoing management thereafter. The grassland that is to be	Slight adverse

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
		Scheme boundary as a result of pollution.	plan for chalk grasslands will be prepared and implemented. Retained areas of designated site to be protected from incursion and pollution prevention measures will be implemented during construction of the Scheme.	newly created will take some time to establish (approximately 10year) and will require ongoing management. Temporary displacement of species supported by the designated site (i.e. reptiles) may occur in the interim due to the temporary loss of habitat available. However, there will be retained habitat adjacent to the Scheme which links to the wider area which could support any displaced individuals in the short-term while translocated habitat establishes. Taking account of the limited temporary loss of habitat, and the provision of additional habitat to that which is lost, the Scheme could result in temporary slight adverse effects on this designated site.	
		Operation: None	None	None	Neutral
Ancient Woodland	National	Construction: None	The sites will be subject to protection from incursion and pollution prevention measures will be implemented during construction of the Scheme.	None	Neutral
		Operation: None	None	None	Neutral
Veteran trees	National	Construction: None	None	None	Neutral
		Operation: None	None	None	Neutral

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
Habitats, including broad-leaved semi-natural woodland, plantation woodland, hedgerows and standing water	Local	Construction: Direct impacts resulting from habitat loss totalling 5.39 ha of woodland, 1142 m of hedgerow and loss of a pond. Potential for indirect adverse impacts to adjacent habitats from pollution and accidental incursion during works.	6.09 ha of woodland will be created, of which approximately 3 ha will be provided in advance and prior to construction works commencing, some of which will be created pre-construction to reduce the time taken until full establishment. 3777 m of hedgerow will be created, with approximately 665 m created in advance. Hedgerow translocation will also take place along Oad Street, Honeycrock Hill and Amels Hill. A pond (approximately 50 m^2) will also be created as part of the Scheme design. Retained habitats will be subject to protection from accidental incursion and pollution prevention measures will be implemented during construction of the Scheme.	Due to the temporary loss of these habitats, as a result of the Scheme, there will be a temporary, slight adverse effect on the favourable conservation status of these habitats, until translocated hedges and new planting becomes established.	Slight adverse
		Operation: Beneficial impacts through an increase in the total area of woodland and hedgerows. Creation of a pond which is of higher ecological value than that lost. Indirect adverse impacts on habitat quality from pollution.	Replacement woodland habitat will total 5.96 ha, resulting in an overall increase in woodland of 0.58 ha. Replacement hedgerow habitat will total 3617 m resulting in an overall increase in hedgerow length of 2485 m Implementation of best practice guidelines for surface water drainage systems. Implementation of a Habitat Management Plan will guarantee	The provision of replacement woodland, hedgerows and a pond provide an overall increase in habitats of value. It is recognised that the benefits from these new habitats will take some time to establish. Therefore, a temporary short-term slight adverse effect whilst the habitats establish is anticipated. Based on an overall increase in the total area of woodland and hedgerow habitats as a result of the Scheme and implementation of a Habitat Management Plan to ensure successful establishment, it is considered	Slight adverse changing to Slight beneficial once vegetation is established

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
			the long-term survival and quality of new habitats.	that there will be slight, positive long-term effects of the favourable conservation status of these habitats once they have become established.	
Bats	Local	Construction: Temporary loss of foraging and commuting habitat, temporary disturbance from noise, lighting and visual disturbance.	Advanced woodland planting will be undertaken prior to construction works commencing to reduce impacts from temporary loss of foraging habitat. New planting and translocation of hedgerows to replace any habitat lost and improve the overall habitat resource for bats. Planting locations are strategically located to improve connectivity to the wider landscape. Bat boxes (8 in total) will be installed to provide roost opportunities within suitable retained habitats. Night working will be avoided where possible and lighting required for construction works will be designed to avoid illuminating adjacent woodland habitat and M2 viaduct. Noise impacts will be mitigated as outlined in Chapter 6.	Based on current data, no loss of roosts is predicted. If new roosts are colonised and retention of confirmed roosts is not practicable, any lost roost will be replaced in line with good practice guidance. Although no roost is confirmed present at M2 viaduct, should one be confirmed during pre- construction survey, sensitive lighting design will be adopted for works around the viaduct to make sure illumination of the underside of the viaduct is avoided Replacement habitats include woodland, scrub and hedgerow and will provide an overall increase in habitats of value to bats, however, these new habitats will take some time to establish. There are alternative high-quality habitats also available immediately adjacent to the Scheme in the form of large areas of woodland and woodland edge habitat (i.e. Chestnut Wood and Church Wood), which is likely to sustain the population of foraging/commuting bats in the short-term until new planting becomes fully established. Taking mitigation measures into account, and the existing levels of light and noise associated with the habitats surrounding the junction it is not anticipated that	Neutral

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
				construction related noise/light would cause an adverse effect on bat populations associated with the Scheme. Therefore, the residual effect on the conservation status of bats in not considered significant.	
		Operation: Adverse impacts from light pollution.	Lighting has been minimised (it is confined to the Stockbury roundabout area only) and designed sensitively to ensure that a dark corridor of vegetation is maintained throughout the Scheme.	Through the maintenance of a dark corridor of vegetation throughout the Scheme, the residual effect on the conservation status of bats is not considered significant.	Neutral
Dormice	County	Construction: Temporary habitat loss, killing, injury and disturbance (through noise, lighting and visual disturbance), damage or destruction of nests.	All clearance works carried out under NE EPSM licence and sensitive working methods and timings will be outlined in a method statement to avoid harm to individuals. Dormouse nest boxes (a minimum of 30 in total) are to be installed in retained habitat to mitigate for temporary loss of suitable habitat. Habitat creation, including advance planting prior to vegetation clearance to compensate for loss of habitat and provide long-term enhancement by increasing the total area of suitable habitat available for dormice as well as improving habitat connectivity. Night working will be avoided where possible and lighting	Suitable dormouse habitats lost (i.e. woodland and scrub) will be replaced by a combination of advanced planting prior to construction works commencing, and through the provision of linear brash piles providing connectivity to retained habitats. Advance planting will have limited suitability to support dormice until it matures (between 5-10 years post-construction). This is based on the presence of dormice in relatively young plantation woodland (approx. 10 years old) immediately surrounding the Scheme. Temporary displacement of individuals may occur in the interim due to the temporary loss of habitat available for breeding and foraging. However, the provision of brash piles will enable movement into retained habitats and there is a large amount of woodland adjacent to the Scheme which is linked to the wider	Moderate adverse

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
			required for construction works will be designed to avoid illuminating adjacent woodland habitat. Noise impacts will be mitigated as outlined in Chapter 6.	area which will support displaced individuals in the short-term while new planting establishes. Taking mitigation measures into account, it is not anticipated that construction related noise/light would cause an adverse effect on dormouse populations associated with the Scheme. Based on the extent of habitat loss, the Scheme could result in temporary moderate adverse effects on the conservation status of dormice.	
		Operation: Potential for beneficial impacts on populations of dormice as a result of habitat creation and enhanced habitat connectivity. Indirect impacts from light pollution.	Replacement habitat will include 6.09 ha of woodland planting and 2.63 ha of scrub planting which will result in an overall increase of 0.69 ha of woodland and 1.88 ha of scrub, increasing the habitat available for this species and enhancing connectivity. Lighting has been minimised (it is confined to the Stockbury roundabout area only) and designed sensitively to ensure that a dark corridor of vegetation is maintained throughout the Scheme.	Habitat creation will provide a total increase in the area of suitable habitat available for dormice for breeding and foraging, which, once fully established (anticipated by year 15 post-construction), will provide a permanent enhancement for this species. Whilst the Scheme has the potential to result in limited lighting disturbance in the Stockbury roundabout area, a dark corridor of vegetation will be maintained throughout the Scheme and significant effects are not anticipated. Therefore, it is considered that there will be slight positive long-term effects on the conservation status of dormice.	Slight beneficial
Breeding Birds	Local	Construction: Direct impacts resulting from temporary habitat loss,	Advanced woodland and scrub planting will be undertaken pre-construction to reduce the time taken until full establishment.	Habitat lost will be replaced by advanced woodland and scrub planting pre-construction, which will provide a limited nesting/foraging resource during construction.	Neutral

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
		potential killing, injury and disturbance. Indirect impacts from noise/light pollution.	Habitat clearance will be carried out outside of the main breeding bird season, or the area to be cleared will be checked by an ecologist within 24 hrs prior to clearance. Night working will be avoided where possible and lighting required for construction works will be designed to avoid illuminating the adjacent vegetation suitable for nesting birds. Nest boxes (32 in total) within suitable habitats will be installed to provide nesting opportunities for breeding birds. Noise impacts will be mitigated as outlined in Chapter 6. This will involve employing good working practices that will minimise any residual noise and vibration impacts, such the use of silencers and mufflers on machinery for the duration of the works where practicable. Temporary noise barriers will be installed where necessary and, and piling methods that result in low levels of vibration, such as rotary bored piling will be employed.	Alternative high-quality nesting/foraging habitat is available immediately adjacent to the Scheme, which is likely to sustain the population of nesting/foraging birds in the short-term until new planting becomes fully established (anticipated by year 15 post-construction). Taking mitigation measures into account, it is not anticipated that construction related noise/light would cause an adverse effect on notable bird populations associated with the Scheme. Therefore, the residual effect on the conservation status of breeding birds is not considered significant.	
		Operation:	Replacement habitat (comprised of advanced pre-construction planting	Habitat creation will provide a total increase in the area of woodland and other	Slight beneficial

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
		Potential for beneficial impacts on abundance and distribution of the population as a result of habitat creation. Indirect impacts from permanent habitat loss, light and noise pollution.	and new habitat creation post-construction) will provide new nesting and foraging opportunities for birds. This will comprise native species-rich assemblages of grassland, scrub and woodland vegetation to maximise the resources available for a range of breeding bird species. Nest boxes will be installed at strategic locations throughout the habitats created to support the local breeding bird population. Lighting has been minimised (it is confined to the Stockbury roundabout area only) and designed sensitively to ensure that a dark corridor of vegetation is maintained throughout the Scheme. Noise impacts during operation will be mitigated as outlined in Chapter 6, which includes the use of low noise road surfacing on the A249.	habitats available for nesting/foraging birds, which, once fully established, will provide a permanent enhancement for these species. These measures will be further enhanced by the provision of nest boxes. The habitat due to be permanently lost, i.e. 12 ha of arable is considered to be of low value to notable breeding birds in its own right, due to disturbance resulting from the proximity to main roads and the lack of wide field verges and areas of set-a-side. During the breeding bird survey this area was found to support very few territories of notable species associated with arable habitat (i.e. part of one skylark territory and one possible yellowhammer territory for example). It is considered that the replacement grassland and tall ruderal habitats in the vicinity of these territories will provide like-for-like foraging resources during construction. Whilst the Scheme has the potential to result in limited lighting disturbance in the Stockbury roundabout area, the majority of the Scheme will not experience any lighting impacts during operation and significant effects as a result of lighting are not anticipated. Noise modelling has predicted that the majority of sensitive receptors will be subject to a beneficial decrease or negligible or minor increase in daytime noise levels in the short- and long-term	

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
				during the operation of the Scheme. The modelling predicted that change in night-time noise levels at receptors will be negligible. Taking the existing levels of light and noise associated with the habitats surrounding the junction it is not anticipated that any increase in noise and light levels during operation would be significant. Therefore, it is considered that there will be slight positive long-term effects on the conservation status of notable birds.	
Wintering Birds	Local	Construction: Direct impacts resulting from temporary habitat loss and disturbance. Indirect impacts from noise/visual/light pollution.	Advanced woodland and scrub planting will be undertaken pre-construction to reduce the time taken until full establishment. Night working will be avoided where possible and lighting required for construction works will be designed to avoid illuminating the adjacent habitats suitable for roosting birds. Noise impacts will be mitigated as outlined in Chapter 6. This will involve employing good working practices that will minimise any residual noise and vibration impacts, such the use of silencers and mufflers on machinery for the duration of the works where practicable. Temporary noise barriers will be installed where necessary and, and piling methods that result in low	Habitat lost will be replaced by advanced woodland and scrub planting pre-construction, which will provide limited foraging and sheltering resource for the majority of species during construction. Alternative high-quality foraging and loafing habitat is also available immediately adjacent to the Scheme, which is likely to sustain the population of the majority of wintering bird species until new planting becomes fully established (anticipated by year 15 post-construction). It is considered that adequate resource is also available in the surrounding landscape for any displaced individuals of species associated with open habitats such as waders, wildfowl and gulls that may be present. Any additional movement into adjacent habitats is unlikely to result in an adverse effect on individual birds' physical condition given that the majority of these species are migratory or have the	Neutral

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
			levels of vibration, such as rotary bored piling will be employed.	propensity to forage or commute over large areas. Taking mitigation measures into account, it is not anticipated that construction related noise/light would cause an adverse effect on notable bird populations associated with the Scheme. Therefore, the residual effect on the conservation status of wintering birds is not considered significant.	
		Operation: Potential for beneficial impacts on abundance and distribution of farmland passerine species as a result of habitat creation. Indirect impacts from permanent habitat loss, light and noise pollution.	Replacement habitat (comprised of advanced pre-construction planting and new habitat creation post-construction) will provide new foraging opportunities for birds. This will comprise native species-rich assemblages to maximise the resources available for a range of breeding bird species. Lighting has been minimised (it is confined to the Stockbury roundabout area only) and designed sensitively to ensure that a dark corridor of vegetation is maintained throughout the Scheme. Noise impacts during operation will be mitigated as outlined in Chapter 6, which includes the use of low noise road surfacing on the A249.	Habitat creation will provide a total increase in the area of woodland and other habitats available for foraging and roosting birds, which, once fully established, will provide a permanent enhancement for these species. Habitat due to be permanently lost, i.e. 12 ha of arable is considered to be of low value to notable wintering birds in its own right, due to disturbance resulting from the proximity to main roads and the lack of wide field verges and areas of set-a-side. During the wintering bird survey this area was found to support very few notable species associated with arable habitat (i.e. small flocks of common gull and black-headed gull and low numbers of skylark and meadow pipit). It is considered that the replacement grassland and tall ruderal habitats will provide like-for-like foraging resources for passerines during construction.	Slight beneficial

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
				It is considered that adequate resource is also available in the surrounding landscape and for any displaced individuals of species associated with open habitats such as waders, wildfowl and gulls that may be present. Any additional movement into adjacent habitats is unlikely to result in an adverse effect on individual birds' physical condition given that the majority of these species are migratory or have the propensity to forage or commute over large areas. Whilst the Scheme has the potential to result in limited lighting disturbance in the Stockbury roundabout area, the majority of the Scheme will not experience any lighting impacts during operation and significant effects as a result of lighting are not anticipated. Noise modelling has predicted that the majority of sensitive receptors will be subject to a beneficial decrease, or negligible or minor increase in daytime noise levels in the short- and long-term during the operation of the Scheme. The modelling predicted that change in night-time noise levels at receptors will be negligible. Taking the existing levels of light and noise associated with the habitats surrounding the junction it is not anticipated that any increase in noise and light levels during operation would be significant. Therefore, it is considered that there will be slight positive long-term effects on the	

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
				conservation status of notable species of wintering birds.	
Reptiles	Local	Construction: Direct impacts resulting from temporary habitat loss, potential killing and injury during construction.	Advance scrub planting and grassland creation will be undertaken pre-construction to reduce the time taken until full establishment with the incorporation of suitable habitat features. Habitat clearance will be carried out under a PMW. Creation of 10 above ground refugia to support reptiles within retained and created habitats.	Habitat lost will be replaced by advanced scrub and grassland planting pre-construction, which will provide a limited resource for reptiles during construction. Alternative high-quality habitat is available immediately adjacent to the Scheme, which is likely to sustain the population of reptiles in the short-term until new planting becomes fully established. Displacement will be temporary and habitat connectivity will be maintained. Therefore, the residual effect on the conservation status of reptiles is not considered significant.	Neutral
		Operation: Potential for beneficial impacts on abundance and distribution of the population as a result of habitat creation.	None	None	Neutral
Invasive non-native plants	N/A	Construction: Potential to cause spread of invasive non-native plants.	A pre- construction survey to identify whether invasive non-native plant species are present within the Scheme. Should such species be confirmed, a specialist contractor will be appointed by the Principal Contractor to oversee the	None	Neutral

Nature conservation receptor	Value	Characterisation of impacts	Mitigation	Residual effect (with mitigation)	Significance category
			removal of invasive non-native plants.		

Significant effects

7.10.2 Based on the valuation of nature conservation receptors (in line with IAN 130/10[198]), the potential impacts identified, and mitigation measures proposed, it is considered that the following nature conservation receptors could potentially be subject to residual slight adverse effects during construction of the Scheme:

- Honeycrock Hill (MA04) and Church Hill, Stockbury (MA11) RNRs; and
- Habitats (woodland, hedgerows and standing water).

7.10.3 Additionally, dormice could potentially be subject to moderate adverse effects during construction of the Scheme.

7.10.4 Considering the new habitats that will be created, the Scheme is likely to have long-term slight positive effects on habitats, dormice, and breeding birds. No adverse residual effects are anticipated during operation of the Scheme.

Residual effects

Honeycrock Hill and Church Hill, Stockbury RNRs

7.10.5 Based on the loss of small portions of these locally designated sites, even with the proposed translocation of chalk grassland and orchids, the Scheme is considered to have a permanent slight adverse effect on the conservation status of these receptors.

Habitats

7.10.6 Due to the time taken for advance planting and newly created habitat to establish, there will be a temporary loss in the total area of habitats (woodland, hedgerows and ponds) during construction of the Scheme and immediately post construction during the establishment of new habitats. Such an impact will have a short-term slight adverse effect on the conservation status of these habitats that is significant at a local scale.

7.10.7 Based on the extent of new habitat creation and measures to ensure successful establishment included in the design of the Scheme, there will be an increase in the total area (and quality) of the above semi-natural habitats during operation of the Scheme, which will have a long-term slight positive effect on the conservation status of these habitats.

Dormice

7.10.8 Due to the time taken for advanced planting and newly created habitat to establish, there will be a temporary reduction in the total area of habitat available for dormice. Additionally, there will be some displacement of individuals. Although the provision of brash piles, connecting retained suitable habitat and providing connections to wider landscape features reduces the effect, a short-term slight adverse effect on the conservation status of dormice is anticipated.

7.10.9 Once new woodland is established, it will provide a total increase in the area of woodland available for dormice during operation of the Scheme, as well as

[198] DMRB IAN 130/10: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian130.pdf.

enhanced habitat connectivity. Therefore, the Scheme is anticipated to result in a long-term slight positive effect on the conservation status of this species.

7.11 Cumulative effects

7.11.1 There are a number of projects and plans that could potentially result in cumulative effects with the Scheme. Chapter 15 sets out the methodology used to define and identify the development projects to be considered as part of the cumulative effects. Figures 15.1 and 15.2 in Volume 3 provide the locations of where the development projects are in relation to the Scheme.

Highways projects

7.11.2 There are no other trunk road projects planned within 10 km of the junction according to the Highways England website.

Development Projects

7.11.3 Four developments have been identified that are of a sufficient scale and nature to result in combined effects with the Scheme. These proposed developments have been considered in relation to potential cumulative effects on biodiversity:

- Land at Woodgate Lane located approximately 100 m from the Scheme. Development of an existing builders' yard for construction of 11 new dwellings, including an access road, garages and car ports.
- Builders Yard at Woodgate Lane located approximately 200 m from the Scheme. Prior notification for change of use of three buildings from Class B8 (storage/distribution) to Class 3 (dwellings/housing).
- Land at Wises Lane located approximately 2.7 km from the Scheme. Hybrid planning application with outline permission (all matters reserved except for access) sought for up to 595 dwellings including affordable housing, a two-form entry primary school with associated outdoor space and parking, local facilities including retail, financial/professional services, restaurants/cafes, community buildings, sports pitches and parking, a link-road between Borden Lane and Chestnut Street/A249, allotments and formal and informal open space incorporating Sustainable Drainage Systems (SuDS), new planting/landscaping and ecological enhancement. Full planning permission sought for 80 dwellings including affordable housing, open space, associated access/roads, parking, associated services, infrastructure, landscaping and SuDS. The total number of dwellings proposed across the site is up to 675.
- Manor Farm located approximately 2.9 km from the Scheme. Outline planning application for residential development for up to 50 dwellings with access off Chestnut Street.

7.11.4 The Land at Woodgate Lane development is consented and will result in loss of habitats with the potential to support reptiles and breeding birds. However, retention of exiting trees and a planting scheme proposed as part of the development is likely to result in negligible adverse effects on these species and cumulative impacts with the Scheme are not considered significant.

7.11.5 Having reviewed the available information for the Builders Yard at Woodgate Lane development, there is no reference to ecology so potential impacts, particularly to bats, are unknown. The desk study data provided for the M2 Junction 5 Scheme did not identify any bat roosts in the Woodgate Lane location. Given that the M2 Junction 5 Scheme would not have significant effects on bats, with the only impacts predicted being temporary loss of foraging and commuting habit used by low numbers of bats and temporary disturbance, it is considered unlikely that there would be significant cumulative effects on bats as a result of both developments. Furthermore, a review of aerial imagery suggests that there is very little connecting habitat between the two locations. Therefore, cumulative impacts on ecological receptors are considered unlikely.

7.11.6 The Land at Wises Lane and Manor Farm developments could add to the total temporary habitat lost within the local area and may contribute to locally significant cumulative impacts on populations of bats, birds, reptiles and invertebrates. However, habitat creation and enhancements at Manor Farm are expected to result in beneficial residual effects for birds, bats and reptiles. As a result of habitat restoration and creation of the Land at Wises Lane, minor to moderate beneficial residual effects are anticipated for bats and invertebrates. However, it is noted that adverse cumulative effects on skylark have been identified. No specific impacts from the M2 Junction 5 improvement Scheme are expected in relation to skylark. The Land at Wises Lane development effects seven skylark territories and has therefore developed a mitigation strategy to provide 22 ha of skylark mitigation plots adjacent to the development. Given that the M2 Junction 5 Scheme overlaps with only part of a single skylark territory it is considered highly unlikely to contribute to the adverse cumulative effects on skylark as identified by the Land at Wises Lane development. Furthermore, given the distance of these developments in excess of 2 km from the Scheme, they are outside of the EZoI for all species associated with the Scheme and are therefore unlikely to contribute to significant cumulative effects.

7.11.7 Assessing the in-combination effects with the Scheme, these developments and residual effects from this Scheme are considered unlikely to contribute to significant cumulative effects due to the distance and the lack of connecting habitat which may otherwise result in impacts to the same populations of the species identified.

7.12 Monitoring

7.12.1 The OEMP (Appendix A in Volume 2) includes details of the committed mitigation measures and requirements for monitoring during and post-construction, and ongoing management to assess and ensure the successful establishment of new habitat creation areas (i.e. broadleaved woodland, species-rich grassland, hedgerows, scrub and pond). The initial maintenance period will encompass the first five years after construction and will be the responsibility of Highways England's Contractor.

7.12.2 Newly created habitats will be monitored as part of the Habitat Management Plan and Landscape and Ecology Management Plan to ensure successful establishment. Monitoring will take the form of arboricultural/ecological surveys (as required) of translocated habitats, newly planted trees, hedgerows, woodland and species-rich grassland to inform appropriate ongoing management practices. Monitoring will be undertaken by walkover survey annually in the first

two years after seeding/planting. Translocated habitats and newly planted trees will be monitored annually throughout the maintenance period. Species-rich grassland created will be monitored using NVC survey methodology in year three. Bird and bat boxes installed within the Scheme will also be monitored, to track the effectiveness of the mitigation design for these ecological receptors. After the maintenance, an ongoing schedule of monitoring of newly created habitats will be agreed with Highways England.

7.12.3 Monitoring will be required as part of the licence conditions for European Protected Species (i.e. dormice). Dormouse populations will be monitored in accordance with the Method Statement, which will be agreed with Natural England. The monitoring will assess the effectiveness of the mitigation methods and determine if new woodland is effective in maintaining the distribution and abundance of this species. The results of the monitoring will be used to inform ongoing management of the new woodland to ensure its long-term suitability in providing suitable habitat for dormice.

7.13 Summary

7.13.1 There are no likely significant effects anticipated as a result of the Scheme or in combination with other plans or projects to the international and national designated sites North Downs Woodlands SAC and Wouldham to Detling Escarpment SSSI. The assessment of air quality effects on North Downs Woodlands SAC (within which Wouldham to Detling Escarpment SSSI is located) is detailed in the Habitats Regulations Assessment report in Appendix D.6 in Volume 2. Air quality impacts to Queendown Warren SSSI are not anticipated as a result of the Scheme and therefore no significant impacts are likely for Queendown Warren SSSI.

7.13.2 The Scheme will involve the loss of 0.08 ha and 0.15 ha of two RNR's situated at the southern extent of the improvement works which will result in a slight adverse effect on the conservation value of these receptors. Habitat will be translocated and additional areas of similar habitat will be created, but the residual effect is as a result of the temporary loss of the habitats and their ability to support notable species known to be within the RNR's.

7.13.3 The Scheme also involves habitat loss which will result in temporary slight adverse effects on the conservation status of broad-leaved semi-natural woodland and plantation woodland (5.4 ha), hedgerows (1142 m) and standing water (342 m^2) during construction. However, due to the habitat creation measures that will be provided as part of the environmental mitigation design, long-term slight beneficial effects are anticipated once the created habitats have become established.

7.13.4 The majority of habitat creation will replace arable farmland, resulting in an increase in the area of terrestrial and aquatic habitats of biodiversity value. Habitat creation will also result in a continuous extension to the woodland cover to the west of Stockbury roundabout which will connect Church Wood with hedgerows along Honeycrock Hill, Amels Hill and Church Hill, thereby increasing connectivity to the wider landscape. The total area of species rich grassland and scrub will also increase, and a significant increase in new native hedgerow will be established. The provision of a replacement pond will also increase the

diversity of standing water habitat as it will be planted with suitable aquatic and marginal vegetation.

7.13.5 The loss of woodland and scrub during construction will result in temporary moderate adverse effects on dormice during construction. However, due to the habitat creation that will be carried out as part of the Scheme, long-term slight beneficial effects are anticipated on the dormouse population once these habitats have become established. Similarly, the increase in total area of grassland, scrub and woodland habitats and the provision of additional nest boxes are anticipated to contribute to long-term slight beneficial effects on the bird population once they are established.

7.13.6 Taking into account the committed design and mitigation measures, no significant impacts are likely for Queendown Warren SSSI, Ancient Woodland, veteran trees, bats, and reptiles.

7.13.7 Post-construction monitoring will be undertaken to ensure the successful establishment of translocated habitats as well as newly created habitats. Additional monitoring for species will include post-construction monitoring of the dormouse population associated with the Scheme as well as the use of bird nest boxes and bat boxes within the Scheme.

7.13.8 The potential for cumulative effects has been assessed and none of the developments identified are considered likely to contribute to cumulative effects due to the distance those developments are from the Scheme and the lack of connecting habitats between them and the Scheme. The full assessment of cumulative effects is provided in Chapter 15.

8. Road Drainage and the Water Environment

8.1 Introduction

8.1.1 This chapter considers the potential impacts to the water environment during the construction and operational phases of the Scheme. The assessment of both surface and groundwater features covers:

- Water quality;
- Flood risk; and
- Water Framework Directive (WFD) compliance.

8.1.2 This chapter is supported by the following technical appendices:

- Appendix E.2 in Volume 2 – Flood Risk Assessment (FRA);
- Appendix E.3 in Volume 2 – Water Framework Directive (WFD) Compliance Assessment; and
- Appendix E.4 in Volume 2 – Drainage Strategy.

8.1.3 The spatial scope of the assessment has included features of the water environment within 1 km of the Scheme.

8.1.4 This chapter does not cover hydrogeological impacts associated with the disturbance of contaminated land or the movement of groundwater flow. Potential impacts to groundwater resources and groundwater quality associated within these aspects have been considered in Chapter 10 Geology and Soils.

8.2 Competent expert evidence

8.2.1 This chapter has been undertaken by the following individuals who have used their knowledge and professional judgement to undertake this assessment:

- Kathryn Gelsthorpe, qualified Senior Environmental Scientist (BSc, MSc, AIEMA, CWEM, MCIWEM, CSci, CEnv) with over 10 years of knowledge and experience in road drainage and the water environment and holds professional membership with the Chartered Institution of Water and Environmental Management (CIWEM) and the Institute of Environmental Management and Assessment (IEMA);
- Emma Everard is a qualified Principal Hydrogeologist (BSc, MSc, CWEM, CSci, CEnv) with over 18 years of knowledge and experience in water resources and the water environment and holds professional membership with CIWEM. Emma is the author of the Groundwater WFD Compliance Assessment which is referred to in this chapter;
- Tom Rouse is a Principal Scientist and is the author of the Flood Risk Assessment (FRA) which is referred to in this chapter. Tom is a chartered water and environmental manager and a chartered scientist (CWEM, MCIWEM) with over twenty years' experience in the water industry; and
- Mark Blackmore, qualified Principal Consultant (BSc, MSc, CWEM, CSci, CEnv). With over 20 years of knowledge and experience in road drainage and the water environment and holds professional membership with

CIWEM. Mark is the reviewer of the Road Drainage and Water Environment chapter.

8.3 Legislative and policy framework

8.3.1 Legislation and policies related to protection and management of the water environment are listed in Table 8.1. The aim of water legislation and policy in England is to protect both public health and the environment by maintaining and improving the quality of water features. This includes all surface water bodies (e.g. rivers, streams, canals, lakes, ponds) and groundwater.

8.3.2 The Department of the Environment, Food and Rural Affairs (Defra) is responsible for all aspects of water policy in England. Management and enforcement of water policy is the responsibility of regulators, principally the Environment Agency, but also Lead Local Flood Authorities (LLFAs).

Table 8.1: Legislation, regulatory and policy framework for road drainage and the water environment

Scale	Legislation/regulation	Summary of requirements
European	Water Framework Directive (2000/60/EC)	The WFD aims to protect and enhance the quality of the water environment. The WFD requires natural surface water bodies to achieve both Good Chemical Status and Good Ecological Status. Artificial and Heavily Modified Water Bodies may be prevented from reaching Good Ecological Status due to the modifications necessary to maintain their function, e.g. navigation. They are, however, required to achieve Good Ecological Potential, through the implementation of a series of mitigation measures. The WFD also requires good status (both qualitative and quantitative) to be achieved for all groundwater bodies and the prevention of the deterioration in groundwater status. In addition, it requires the achievement of objectives and standards for protected areas; and the reversal of significant and sustained upward trends in pollutant concentrations in groundwater. Status is reported at the water body scale, with individual water bodies forming part of larger river basin districts (RBD), for which river basin management plans (RBMPs) have been developed. The first RBMPs were published in 2009 followed by a Cycle 2 update published in 2016.
	Environmental Quality Standards Directive (2013/39/EU)	Lists environmental quality standards (EQS) for priority substances and certain other pollutants as provided for in Article 16 of the WFD, with the aim of achieving good surface water chemical status. It includes certain substances that may be associated with run-off from highways.
	Habitats Directive (92/43/EEC)	To promote the maintenance of biodiversity by taking measures to maintain or restore natural habitats and wild species at a favourable conservation status, introducing robust protection for those habitats and species of European importance. Sites or species

Scale	Legislation/regulation	Summary of requirements
		that come under this Directive will heighten the importance of water features that sustain them.
	Floods Directive (2007/60/EC)	The aim is of this Directive is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. It sets the strategic level for flood risk that any development will need to comply with.
National	National Planning Policy Framework (NPPF) 2019	The NPPF sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow. It forms the basis of assessment of flood risk for schemes.
	National Networks National Policy Statement (NN NPS)	Guidance and policy are set out in detail in paragraphs 5.219 to 5.231 of the NN NPS for water quality and resources and in paragraphs 5.90 to 5.115 for flood risk. The objectives include reference to the WFD and that new and existing development should be prevented from contributing to, or being put at unacceptable risk from, or being adversely affected by, water pollution. Existing status of water quality, water resources and physical characteristics in the water environment must be ascertained and that the impacts of the proposed project, including those associated with any cumulative effects, are assessed as part of the Environmental Statement. Careful design to facilitate adherence to good pollution control practice can reduce the risk of impacts on the water environment. For flood risk the NPPF is outlined with reference to the tests to be applied, decision making, and potential mitigation required.
	Anti-pollution Works Regulations (1999)	Where pollution occurs or is likely to occur the Environment Agency can serve a works notice under Section 161A of the Water Resources Act on any person who has caused or knowingly permitted the pollution (or risk of pollution) to a watercourse, requiring them to carry out anti–pollution/preventative works and operations. The Environment Agency can also recover the costs of any investigation and anti–pollution works carried out. The Anti–Pollution Works Regulations prescribe the content of anti–pollution works notices and the particulars that need to be placed on the pollution control registers maintained by the Environment Agency.
	Environment Act (1995)	The Act provides for the establishment of a body corporate to be known as the Environment Agency, the key regulator for the water environment.
	Environmental Damage (Prevention and Remediation) Regulations (2015)	The emphasis of these Regulations is proactively putting in place appropriate pollution prevention measures to reduce risks to the environment.
	Environmental Protection Act (1990)	This Act brings in a system of integrated pollution control for the disposal of wastes to land, water and air.

Scale	Legislation/regulation	Summary of requirements
	Flood Risk Regulations (2009) Amended 2009/3042	These Regulations transpose the Floods Directive (2007/60/EC). They aim to provide a consistent approach to managing flood risk. The Environment Agency are responsible for managing flood risk from main rivers, the sea and reservoirs. LLFAs are responsible for local sources of flood risk, in particular surface water, groundwater and ordinary watercourses.
	Flood and Water Management Act 2010 and Commencement Orders	The key areas covered by this Act are: • Roles and responsibilities for flood and coastal erosion risk management; and • Improving reservoir safety.
	Highways Act 1980 (HA 1980)	The Act deals with the management and operation of the road network in England and Wales including the drainage of highways into environmental waters and sewers.
	National Planning Practice Guidance (NPPG) 2018	Accompanying the NPPF, the NPPG (DCLG, 2018) was published in 2014 and updated in 2018. This advises on how Local Planning Authorities can ensure protection of water quality, the delivery of adequate water infrastructure and take account of the risks associated with flooding in the plan–making and the planning application process.
	The Environmental Permitting (England and Wales) Regulations 2016	These Regulations provide a consolidated system of environmental permitting in England and Wales and transpose provisions of fifteen EU Directives which impose obligations requiring delivery through permits or which are capable of being delivered through permits. Covers Environment Agency permits for flood risk (on Main River) and certain discharges to watercourses.
	The Water Resources (Environmental Impact Assessment) (England and Wales) Regulations 2003, amended 2017	These Regulations impose procedural requirements in relation to the consideration of applications or proposals for an abstraction or impounding licence under Chapter II of Part II of the Water Resources Act 1991 and require consent in other cases.
	Water Act 2003 and Water Act 2014	These Acts aim to improve water conservation, protect public health and the environment, and improve the service offered to consumers. The basis of the Act is three parts relating to water resources, regulation of the water industry and other provisions.
	Water Framework Directive (Standards and Classification) Directions (England and Wales) 2017	These Directions set out the environmental standards to be used for the second cycle of river basin plans. They transpose Directive 2013/39/EU on environmental quality standards for priority substances. They also cover Specific Pollutants which include certain metals that are associated with road are associated with road drainage.
	Water Industry Act (1991) (Amendment) (England and Wales) Regulations (2009)	This Act sets out the responsibilities of the Environment Agency of England and Wales in relation to water pollution, resource management, flood defence, fisheries, and in some areas, navigation. The Act regulates discharges to

Scale	Legislation/regulation	Summary of requirements
		controlled waters, namely rivers, estuaries, coastal waters, lakes and groundwaters.
	Water Resources Act 1991	This Act sets out to regulate water resources, water quality and pollution, and flood defence. It sets out standards for Controlled Waters.
	Water Environment (Water Framework Directive) (England and Wales) Regulations 2003	These Regulations outline the duties of regulators (Environment Agency in England) in relation to environmental permitting, abstraction and impoundment of water.
	The Land Drainage Act 1991 and 1994	This Act requires that a watercourse be maintained by its owner in such a condition that the free flow of water is not impeded. The 1994 Act amends it in relation to the functions of internal drainage boards and local authorities.
	The Control of Pollution (Oil Storage) (England) Regulations 2001	Applicable for storage of more than 200 litres of oil above ground at an industrial, commercial or institutional site, then these Regulations affect you. The sites they cover include; factories, shops, offices, hotels, schools, churches, public sector buildings and hospitals. The Regulations apply only in England.
Regional	Thames River Basin Management Plan (RBMP)	This RBMP is designed to protect and improve the quality of the water environment. It includes consideration of the following topics: • Plans for the protection and improvement of the water environment; • Future plans that may affect the infrastructure sector and its obligations; • Development proposal considerations regarding the requirements of the plan; and Environmental permit applications.
Local	Maidstone Borough Local Plan	The Maidstone Borough Local Plan includes the following policy related to the water environment: • Policy DM3 Natural Environment – To enable Maidstone borough to retain a high quality of living and to be able to respond to the effects of climate change, developers will ensure that new development protects and enhances the natural environment by incorporating measures where appropriate to: – Control pollution to protect ground and surface waters where necessary and mitigate against the deterioration of water bodies and adverse impacts on Groundwater Source Protection Zones, and/or incorporate measures to improve the ecological status of water bodies as appropriate; and – Mitigate for and adapt to the effects of climate change.

Scale	Legislation/regulation	Summary of requirements
	Bearing Fruits 2031: The Swale Borough Local Plan	The following policies relate to the water environment: • Policy CP7 Conserving and Enhancing the Natural Environment; • Policy DM19 Sustainable Design and Construction; and • Policy DM21 Water, flooding and drainage.

Table Source: Various

8.4 Study area

8.4.1 The spatial scope of the assessment includes all features of the water environment within 1 km of the Scheme boundary. This encompasses all the areas to be used for construction of the Scheme. In accordance with HD 45/09 (HA, 2009), a 1 km study area is considered appropriate for the assessment of surface water quality soluble pollutants and therefore has been used throughout the water environment assessment. The study area includes WFD surface water and groundwater bodies and groundwater Source Protection Zones (SPZ), where present. For groundwater, the potential zone of impact assessed was on the underlying WFD groundwater body. This groundwater assessment includes the potential zone of influence caused by any dewatering required for construction and operational use.

8.5 Assessment methodology

8.5.1 The water environment assessment includes consideration of water quality (both surface and groundwater), flood risk and compliance with the WFD for both surface and groundwater. This chapter does not cover hydrogeological impacts associated with the disturbance of contaminated land or the movement of groundwater flow. Potential impacts to groundwater resources and groundwater quality associated with these aspects have been considered in Chapter 10 Geology and Soils.

Water quality

8.5.2 HD 45/09 (HA, 2009)[199], provides guidance on the assessment of the likely significance of effects on the water environment associated with highway schemes. The assessment methodology for this Scheme follows this guidance and the relevant criteria provided. Overall, the significance of potential effects on the water environment has been determined by assessing the importance of the water receptors and magnitude of the impact of the Scheme (including mitigation measures).

Flood risk

8.5.3 In addition to the guidance and criteria provided in HD 45/09 (HA, 2009), a FRA has been undertaken in accordance with the requirements of the NPPF (DCLG, 2012)[200] and its accompanying Technical Guidance (DCLG, 2014), and the

[199] Design Manual for Roads and Bridges. Volume 11 Section 3. Part 10. HD 45/09. Road Drainage and the Water Environment. November 2009
[200] Department for Communities and Local Government (2019). National Planning Policy Framework. London: DCLG.

Environment Agency's 'Climate change allowances for planners' NPPF supporting guidance (Environment Agency, 2019)[201]. The FRA is also in line with HD 45/09 (HA, 2009).

Water Framework Directive

8.5.4 A WFD compliance assessment has been undertaken following the Planning Inspectorate's (PINS) guidance on the preparation of WFD assessments (PINS, 2017)[202]. It is based on a format that was originally developed in close consultation with the Environment Agency and is promoted as an example of best practice. It captures the core requirements of a compliance assessment whilst being transparent and simple to interpret.

8.5.5 The WFD compliance assessment is a standalone report (Appendix E.3 in Volume 2) which considers the impacts of the Scheme at a water body scale. For surface water bodies, the WFD compliance assessment considers the potential impact of the Scheme on ecological and chemical components. Ecological compounds include: biological quality elements; physico-chemical elements; hydromorphology supporting elements; and specific pollutants. Chemical components include: priority substances and priority hazardous substances. For groundwater water bodies, the WFD compliance assessment considers the potential impact of the Scheme on quantitative components and qualitative components.

8.5.6 To determine whether water body components are affected by the Scheme, cross-checks have been made with Chapter 7 Biodiversity and Chapter 10 Geology and Soils. The Biodiversity chapter (Chapter 7) provides data specifically relating to biological quality elements of a surface water body and the Geology and Soils chapter (Chapter 10) provides data specifically relating to the chemical quality of a groundwater water body. The HD 45/09 (HA, 2009) assessment methods have also been incorporated in the WFD compliance assessment, specifically those used to determine risks of deterioration to water quality (i.e. from specific pollutants, priority and priority hazardous substances).

8.5.7 The following activities were undertaken as part of the baseline assessment for the study area:

- Identification of surface water bodies: rivers, ditches, lakes;
- Identification of groundwater bodies;
- Identification of licensed water abstractions and discharges (both surface and groundwater);
- Identification of current and historic flood risk;
- Collation of water body characteristics and WFD classification;
- Identification of international/nationally designated conservation sites with citations related to the water environment;
- Identification of groundwater designations, for example the presence of Source Protection Zones (SPZ) and aquifers; and

[201] Environment Agency's 'Climate change allowances for planners' NPPF supporting guidance (Environment Agency, 2019.
[202] Planning Inspectorate's guidance on the preparation of WFD assessments 2017.

- Identification of Scheme design elements relevant to the water environment assessment such as (but not limited to) outfalls, soakaways, piling and gantries.

8.5.8 Baseline conditions have been determined through desk studies. The desk studies included a review of the following information:

- The Preliminary Design including design drawings (Scheme Drawings, Figure 2.2 in Volume 3);
- Ordnance Survey (OS) raster mapping on 1:10,000, 1:25,000 1:50,000, and 1:250,000 scale;
- Envirocheck report (Appendix G.2 in Volume 3);
- British Geological Survey 1:50,000 bedrock and superficial geology mapping (BGS, 2018);
- Environmental datasets held on Defra's MAGIC website (Defra, 2018)[203];
- Groundwater level data from Southern Water and the Environment Agency (2018)[204];
- Environment Agency flood maps[205]; and
- Environment Agency's Catchment Data Explorer (Environment Agency, 2018)[206].

Consultation

8.5.9 There has been ongoing stakeholder consultation through meetings with key stakeholders.

8.5.10 Key issues raised by the Environment Agency included concerns associated with groundwater owing to the sensitive nature of the underlying aquifers, especially as part of the Scheme lies within a Source Protection Zone 1. However, the Environment Agency have been consulted through the development of the proposed drainage strategy.

8.5.11 Consultation with regulators (principally the Environment Agency) and Kent County Council (LLFA) will be ongoing throughout the design process to ensure that the Scheme is designed sympathetically to the water environment.

Prediction and evaluation of effects

Water quality

8.5.12 The prediction and evaluation of the effects of the Scheme for water quality and flood risk, follows the requirements and detailed assessment method set out in HD 45/09. As drainage for this Scheme is to groundwater only, part of the Method A test for assessing Run-off Specific Thresholds (RSTs) and suspended sediment is not relevant, as these thresholds have been developed using toxicity data from aquatic organisms and fish and designed for the protection of aquatic surface water features. Equally, the impacts of suspended sediment are based

[203] http://magic.defra.gov.uk/
[204] https://www.southernwater.co.uk/groundwater
[205] https://flood-map-for-planning.service.gov.uk/
[206] https://environment.data.gov.uk/catchment-planning/

on the impact of the physical accumulation altering aquatic habitats smoothing surfaces.

8.5.13 The other methods apply and are outlined in Table 8.2.

Table 8.2: Methods used for the water quality assessment (HD45/09)

Method	Description
Method A	This method focuses on the dilution of routine run-off and pollutants. The method is a simple assessment approach and includes the use of Highways Agency Water Risk Assessment Tool (HAWRAT) considering dilution of indicator metals (dissolved zinc and dissolved copper). The HAWRAT tool is designed to make an assessment of the short-term risks (Run-off Specific Thresholds (RSTs) – 6 hours and 24 hours) related to significant pollutants found in highway run-off (including but not limited to copper, zinc, cadmium and Polycyclic Aromatic Hydrocarbons (PAHs)) as well as the long-term (annual) risks (EQS). The methodology for routine run-off involves tests to predict future concentrations of zinc and copper in receiving watercourses with the addition of discharge from a Scheme. This is based on Annual Average Daily Traffic (AADT) flows, catchment size for the road, dilution flows (Q95) and current water quality (hardness) for each receiving watercourse.
Method B	This method follows on from Method A. The method is a detailed assessment approach focusing on the long-term risks should a risk has been identified in Method A. If the predicted long-term annual averages exceed either of the EQS values for copper or zinc then the bioavailability of these metals needs to be assessed using a Biotic Ligand Model (BLM). If Method B also reports a failure of the EQSs, the designer should aim to achieve compliance with both EQSs and RSTs but at sites where this is difficult the design should at least provide sufficient treatment to comply with the EQSs.
Method C	This method focuses on groundwater effects. This is the standard method for assessing the impact of a Scheme on groundwater quality. Typically, this considers the risk of pollution to groundwater from discharges associated with a Scheme.
Method D	This method focuses on the probability of a serious spillage risk occurring that would affect the water environment. The method provides the return period of a serious accident based on road length, road characteristics (e.g. presence of junctions, roundabouts, and crossroads) AADT, percentage of heavy goods vehicles (HGVs), spillage risk factors and emergency services response time (based on site environment – e.g. urban/rural).
Method E	Hydrological Assessment of Design Floods. This gives generic guidance to estimation of flood events for catchments.
Method F	Hydraulic Assessment. This gives direction as to what is required in a flood consequences assessment and the process of hydraulic modelling to determine flood risk.

8.5.14 The specific requirements or thresholds to protect the water environment are shown in Table 8.3. For Method A, the thresholds are EQS for dissolved copper and zinc which are stated in HD 45/09 and must not be exceeded. It should be noted, the standards set out in HD 45/09 are legacy standards and have since been replaced by bio-availability standards. However, the standards stated in HD 45/09 are still appropriate and relevant as they provide an indication of the likelihood of potential impacts.

Table 8.3: Water quality thresholds (HD 45/09)

Method	Parameter	Limit/threshold
Method A EQS	Downstream dissolved zinc concentrations	7.8 µg/l
Method A EQS	Downstream dissolved copper concentrations	1 µg/l for <50 mg/l CaCO3 6 µg/l for >50 - 100 mg/lCaCO3 10 µg/l for 100 - 250 mgCaCO3 28 µg/l for >250mg/l CaCO3
Method A Sediment	Deposition index (extent of sediment coverage)	100 (pass/fail/protected area)
Method B EQS	Downstream dissolved copper and zinc concentrations	Site-specific (if Method B undertaken)
Method C	Low risk Medium risk High risk	Risk score <150 Risk score 150-250 Risk score >250
Method D	Risk of an accidental spillage reaching a watercourse or groundwater; risk of a serious pollution incident results from the accidental spillage; and the return period calculated for the risk of a pollution incident.	Acceptable risk of a serious pollution incident occurring will be where the annual probability is predicted to be <1% Where road run-off discharges within 1 km of a natural wetland or designated wetlands or it could affect important drinking water supplies or other important abstractions the risk of a serious pollution incident has an annual probability of <0.5%.

Flood risk

8.5.15 The assessment methodology for flood risk broadly follows HD 45/09 Method E – Hydrological Analysis of Design Floods and Method F – Hydraulic Assessment. The assessment methodology deviates from HD 45/09 where updates in policy and industry standard procedures for flood risk hydrological and hydraulic analysis have changed. The latest Environment Agency guidance on design flood estimation and flood modelling has been followed as appropriate for the analysis undertaken.

Groundwater

8.5.16 The specific requirements and threshold risk levels to protect groundwater are shown in Table 8.3 (HD45/09 Method C) above. In conjunction with this, the simple index approach outlined in the Construction Industry Research and Information Association (CIRIA) Sustainable Drainage Systems (SuDS) Manual (C753) was also undertaken and provided guidance in the selection of mitigation.

Water Framework Directive

8.5.17 As noted above, the WFD compliance assessment is a standalone report (Appendix E.3 in Volume 2) which considers the impacts of the Scheme at a water body scale. The baseline WFD status and objectives are first considered, followed by identification of scheme components potentially affecting WFD waterbodies. An assessment of the compliance of each Scheme component with the requirements of the WFD is made.

8.5.18 The HD 45/09 (HA, 2009) assessment methods have also been incorporated in the WFD compliance assessment, specifically those used to determine risks of deterioration to water quality (i.e. from specific pollutants, priority and priority hazardous substances).

8.5.19 HD 45/09 methodology starts with identification of the importance of the environmental attributes within the Scheme study area. The magnitude of impact of the Scheme on the attribute is then determined using calculations and tests from the HD45/09, taking into consideration the influence of mitigation measures. The combination of the importance of an attribute and the magnitude of impact on that attribute gives a significance of potential effect.

Impact assessment criteria

Water quality, flood risk and groundwater

8.5.20 The assessment of the importance of attributes, the magnitude of impacts and the significance of effects are outlined in Table 8.4.

8.5.21 The assessment criteria used follows those set out in HD 45/09 and is shown in Tables 8.4 to Table 8.6. Examples for evaluating the importance of water attributes are shown in Table 8.4. Examples for assessing the magnitude of impacts are shown in Table 8.5. A matrix for determining significance of effects is shown in Table 8.6.

Table 8.4: Estimating the importance of water environment attributes (HD 45/09)

Importance	Criteria	Typical examples
Very High	Attribute has a high quality and rarity on regional or national scale	Surface water: EC Designated Salmonid/Cyprinid fishery; WFD class high; and Site protected/designated under European Community (EC) or United Kingdom (UK) habitat legislation (Special Area Conservation (SAC), Special Protection Area (SPA), Site of Special Scientific Interest (SSSI), Water Protection Zone (WPZ), Ramsar site, salmonid water) / species protected by EC legislation.
		Groundwater: Principal aquifer providing a regionally important resource or supporting site protected under EC and UK habitat legislation; and Source Protection Zone (SPZ) 1.
		Flood risk: Floodplain or defence protecting more than 100 residential properties from flooding.
High	Attribute has a high quality and rarity on local scale	Surface water: WFD class good; Major Cyprinid Fishery; and Species protected under EC or UK habitat legislation.

Importance	Criteria	Typical examples
		Groundwater: Principal aquifer providing locally important resource or supporting river ecosystem; and SPZ2.
		Flood risk: Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding.
Medium	Attribute has a medium quality and rarity on local scale	Surface water: WFD class moderate.
		Groundwater: Aquifer providing water for agricultural or industrial use with limited connection to surface water; and SPZ3.
		Flood risk: Floodplain or defence protecting 10 or fewer industrial properties from flooding.
Low	Attribute has a low quality and rarity on local scale	Surface water: WFD class poor.
		Groundwater: Unproductive strata.
		Flood risk: Floodplain with limited constraints and a low probability of flooding of residential and industrial properties.

Table 8.5: Estimating the magnitude of an impact on an attribute (HD 45/09)

Magnitude	Criteria	Typical examples
Major adverse	Results in loss of attribute and/or quality and integrity of the attribute	Surface water: Failure of both soluble and sediment-bound pollutants in HAWRAT and compliance failure with EQS values; Calculated risk of pollution from a spillage >2% annually Loss or extensive change to a fishery; and Loss or extensive change to a designated Nature Conservation Site.
		Groundwater: Loss of, or extensive change to, an aquifer; Potential high risk of pollution to groundwater from routine run-off – risk score >250; Calculated risk of pollution from spillages >2% annually; and Loss of, or extensive change to, groundwater supported designated wetlands.
		Flood risk: Increase in peak flood level (1% annual probability) >100 mm.

Magnitude	Criteria	Typical examples
Moderate adverse	Results in effect on integrity of attribute, or loss of part of attribute	Surface water: Failure of both soluble and sediment-bound pollutants in HAWRAT but compliance with EQS values; Calculated risk of pollution from spillages >1% annually and <2% annually; and Partial loss in productivity of a fishery.
		Groundwater: Partial loss, or change to, an aquifer; Potential medium risk of pollution to groundwater from routine run-off - risk score 150-250; Calculated risk of pollution from spillages >1% annually and <2% annually; and Partial loss of the integrity of groundwater supported designated wetlands.
		Flood risk: Increase in peak flood level (1% annual probability) >50 mm.
Minor adverse	Results in some measurable change in attributes quality or vulnerability	Surface water: Failure of either soluble or sediment-bound pollutants in HAWRAT; and Calculated risk of pollution from spillages >0.5% annually and <1% annually.
		Groundwater: Potential low risk of pollution to groundwater from routine run-off – risk score <150; Calculated risk of pollution from spillages >0.5% annually and <1% annually; and Minor effects on groundwater supported wetlands.
		Flood risk: Increase in peak flood level (1% annual probability) >10 mm.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	The Scheme is unlikely to affect the integrity of the water environment.
		Surface water: No risk identified by HAWRAT (Pass both soluble and sediment-bound pollutants); and Risk of pollution from spillages <0.5%.
		Groundwater: No measurable impact upon an aquifer and risk of pollution from spillages <0.5%.
		Flood risk: Negligible change in peak flood level (1% annual probability) <+/- 10 mm.
Minor beneficial	Results in some beneficial effect on attribute or a reduced risk of	Surface water: HAWRAT assessment of either soluble or sediment-bound pollutants becomes a Pass from an existing site where the baseline was a Fail condition; and Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually).

Magnitude	Criteria	Typical examples
	negative effect occurring	Groundwater: Calculated reduction in existing spillage risk by 50% or more to an aquifer (when existing spillage risk <1% annually).
		Flood risk: Reduction in peak flood level (1% annual probability) >10 mm.
Moderate beneficial	Results in moderate improvement of attribute quality	Surface water: HAWRAT assessment of both soluble and sediment-bound pollutants becomes a Pass from an existing site where the baseline was a Fail condition; and Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually).
		Groundwater: Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually).
		Flood risk: Reduction in peak flood level (1% annual probability) >50 mm.
Major beneficial	Results in major improvement of attribute quality	Surface water: Removal of existing polluting discharge, or removing the likelihood of polluting discharges occurring to a watercourse.
		Groundwater: Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring; and Recharge of an aquifer.
		Flood risk: Reduction in peak flood level (1% annual probability) >100 mm.

Table 8.6: Estimating the significance of potential effects (HD 45/09)

		Magnitude			
		Negligible	Minor	Moderate	Major
Importance	Very High	Neutral	Moderate/Large	Large/Very Large	Very Large
	High	Neutral	Slight/Moderate	Moderate/Large	Large/Very Large
	Medium	Neutral	Slight	Moderate	Large
	Low	Neutral	Neutral	Slight	Slight/Moderate

8.5.22 As a general rule, very large to moderate effects are considered significant and slight and neutral effects are not considered significant, in accordance with standard EIA practice.

WFD Compliance Assessment

8.5.23 A WFD compliance assessment is required for new developments to demonstrate that proposals will not result in a deterioration in status (or potential) of any water body (defined in this assessment as Test A) or prevent the water

body from meeting good status (or potential) in the future (2021 or 2027) (defined in this assessment as Test B).

8.5.24 The Scheme was assessed for its effect on achieving the two key environmental objectives. This was undertaken for each water body where the Scheme resulted in some modification to a water body or an indirect effect to the volume or quality of water within a water body.

8.5.25 A precautionary risk-based approach was taken to the assessment. This considered tests A and B, accounting for uncertainty of potential impacts. The level of information available at the preliminary design stage, as well as the lack of detailed baseline information for the water bodies assessed was taken into account.

8.5.26 A colour coding “Red, Amber, Green” (RAG) system was used for the risk-based approach. Definitions for the colour coding were assigned to indicate the level of risk of objective non-compliance within each water body, accounted for mitigation assumed to be ‘embedded’ into later phases of the design. Further details of the WFD compliance assessment methodology are provided in Appendix E.2 in Volume 2.

8.6 Assumptions and limitations

8.6.1 The following assumptions and limitations are noted:

- There is limited information regarding the existing drainage system and therefore pre and post Scheme water quality impacts cannot be assessed at the time of reporting. Detailed surveys are due to take place which may provide more clarity on the existing drainage system. However, at the time of reporting, the existing soakaways identified on Highways Agency Drainage Data Management System (HADDMs) are labelled as low risk;
- There is an assumption that one of the road catchments (catchment 7) would discharge to groundwater. It is assumed that this discharge would be outside any zones that are sensitive due to the presence of water abstractions for drinking water supply (i.e. Source Protection Zones); and
- Compliance with the WFD Directive can only be fully demonstrated once detailed designs of a scheme have been prepared. The compliance assessment presented in this document accompanies the preliminary design. To update the WFD compliance assessment (an iterative process), groundwater level data for the Chalk and Thanet Formation in the vicinity of the Scheme are required (from the intrusive ground investigation), together with updated HAWRAT results (if available). The Environment Agency and local catchment partnerships may also provide further information on measures to improve the WFD status of affected water bodies.

8.7 Baseline conditions

8.7.1 Figure 8.1 in Volume 3 shows the water environment features in the study area.

Surface water

8.7.2 The study area is located within the Thames River Basin District (RBD) and lies within the Kent North WFD management catchment[207].

8.7.3 There are no Main Rivers in the study area and no other mapped surface watercourses are crossed by the existing M2 Junction 5. There are no WFD designated surface watercourses within the study area.

8.7.4 A ditch system (likely to be classified as an 'ordinary watercourse') appears to be correlated to a floodplain mapped on the Environment Agency (2019) Flood Map for Planning around the existing alignment of the A249 Sittingbourne Road, the M2/A249 roundabout junction, Maidstone Road and junction with the M2. The ditch system is not illustrated on Ordnance Survey mapping and will need further identification during survey work.

8.7.5 During the environmental scoping stage[208], a small pond was identified adjacent to a property called 'The Gate House' and close to the eastern slip road of the M2 (from the A249 to join the westbound M2 carriageway). This feature was investigated and found to be artificial, of no ecological value and potentially an attenuation pond forming part of the surface water management system for the highway network. Following consultation with the property owners, this feature will be removed as part of the Junction 5 improvement works and associated new highways drainage.

Surface water abstractions

8.7.6 The Environment Agency has confirmed (see Appendix E.1 in Volume 2) that there are no current surface water abstraction licences within 1 km of the Scheme. Surface water abstractions will therefore not be considered further in this assessment.

Surface water discharges

8.7.7 The Environment Agency has confirmed (see Appendix E.1 in Volume 2) that there are no current surface water discharge licences within 1 km of the Scheme. Surface water discharges will therefore not be considered further in this assessment.

Flood risk

Fluvial flood risk

8.7.8 The Environment Agency (2019) Flood Map for Planning indicates that the existing alignment of the A249 Sittingbourne Road, the M2/A249 roundabout junction, Maidstone Road and junction with the M2 motorway, are in a high-risk Flood Zone 3. However, this has been confirmed by the Environment Agency to be incorrect and the site actually falls within a low risk Flood Zone 1 (see email in Appendix E.1 in Volume 2). The floodplain is associated with a ditch system that flows parallel to the A249 and, further north, Maidstone Road and Chestnut Street.

[207] Environment Agency Catchment Data Explorer, accessed May 2018
[208] M2 Junction 5 Environmental Scoping Report, Atkins, October 2018

8.7.9 The ditch system is likely to be classified as an 'ordinary watercourse' and is therefore under the jurisdiction of Kent County Council which acts as the LLFA for this area. The alignment of the watercourse is not illustrated on Ordnance Survey mapping and will need further identification during survey work.

Surface water flood risk

8.7.10 The Scheme is in an area that is affected by overland flow draining from the natural catchment to the south of the Scheme. The catchment is approximately 25 km^2. The overland flow from this catchment forms a flow path along and adjacent to the A249 at the M2 junction.

8.7.11 The Environment Agency Surface Water Flood Risk map highlights the ditch system as a zone at high risk from surface water flooding, described as having a 3.33% (1 in 30) or greater annual probability of flooding in any year.

8.7.12 An attenuation pond has been identified adjacent to the eastern slip road (from the A249 to join the westbound M2 carriageway) and is believed to form part of the surface water management system for the highway network. Another pond exists adjacent to property known as The Gate House. As highlighted above, this feature was investigated and found to be artificial, of no ecological value and potentially an attenuation pond forming part of the surface water management system for the highway network. Following consultation with the property owners, this feature will be removed as part of the Junction 5 improvement works and associated new highways drainage.

8.7.13 There is a history of surface water flooding at the location of The Gate House pond and at Vale Cottages, described by residents, as well as on land to the north of the M2 viaduct, between the A249 and Maidstone Road. This flooding is not represented in HADDMS.

8.7.14 HADDMS contains a record of highway flood events in the area, typically occurring in autumn/winter (August to November) and vary in severity from 0 to 7 (where 10 is the maximum flood severity). The A249 within the study area has been classified with a 'very high' flood hotspot status. The historical flood events on the highway are likely to be due to an inadequate existing drainage system, or poor asset condition and maintenance resulting in reduced hydraulic capacity.

Groundwater flood risk

8.7.15 Based on the BGS 1:50,000 scale groundwater flooding susceptibility map (contained in Envirocheck report, 2017), the Scheme is located in an area which has a 'limited potential for groundwater flooding to occur'. The study area has a 'negligible risk' of groundwater flooding in the 1:50,000 scale ESI Groundwater Flood Map produced by ESI consulting (contained in Envirocheck report 2015). Groundwater flood risk will therefore not be considered further in this assessment.

8.7.16 Although there is no available groundwater level data for the study area itself, Environment Agency groundwater level data from nearby observation boreholes suggest that depth to groundwater is likely to be greater than the maximum depth of below ground intrusive works.

Groundwater

8.7.17 A summary of the geology within the context of the groundwater environment is provided here. Further detail, particularly regarding Made Ground, soils and local geology can be found in Chapter 10 Geology and Soils. Figure 8.2 in Volume 3 shows the groundwater features for the Scheme.

8.7.18 Based on geological open data (1:50,000 scale BGS mapping) (BGS, 2018) the study area is underlain by the Lewes Nodular Chalk Formation to the southwest, which is overlain by the Seaford Chalk Formation across most of the study area. The Seaford Chalk Formation is overlain by isolated outcrops of Thanet Formation (to the southeast of the Stockbury roundabout and to the northeast of the A249).

8.7.19 In terms of superficial deposits, the BGS mapping (1:50,000 scale) shows Head deposits overlying the Chalk along the route of the A249. Clay-with-flints deposits overlie the Chalk to the east of the Junction 5, at the edge of the project area.

8.7.20 Table 8.7 summarises the generalised geological sequence in the study area and the Environment Agency aquifer designation of each geological formation.

Table 8.7: Generalised geological sequence

Period	Formation/sub-unit	Lithology	Environment Agency aquifer designation
Quaternary	Head	Comprises sand and gravel with lenses of silt, clay or peat and organic material.	Secondary (undifferentiated)
	Clay-with-Flints	The dominant lithology is orange-brown and red-brown sandy clay with abundant nodules and rounded pebbles of flint. May locally include bodies of sand, reddish brown clayey silt, and sandy clay.	Unproductive
Tertiary	Thanet Sands	Glauconite-coated, nodular flint at base, overlain by pale yellow-brown, fine-grained sand that can be clayey and glauconitic.	Secondary A
Cretaceous	White Chalk Sub-Group: Lewes Nodular Chalk Formation, Seaford Chalk Formation & Newhaven Chalk Formation (undifferentiated)	Chalk with flints. With discrete marl seams, nodular chalk, sponge-rich and flint seams throughout.	Principal Aquifer

8.7.21 The study area is underlain by the North Kent Swale Chalk groundwater body (WB ID GB40601G501700).

8.7.22 The North Kent Swale Chalk groundwater body (WB ID GB40601G501700) lies immediately to the south of the North Kent Tertiaries groundwater body (WB ID GB40602G500200). The proposed junction improvement works do not extend into the North Kent Tertiaries groundwater body and it is not anticipated that any works from the Scheme will impact the North Kent Tertiaries groundwater body. It was therefore screened out of the WFD compliance assessment.

8.7.23 The WFD water body status for the North Kent Swale Chalk groundwater body is summarised in Table 8.8.

Table 8.8: Groundwater body WFD status

Receptor	2016 Cycle 2 overall status	Quantitative status element	Chemical status element	Overall objective
North Kent Swale Chalk (GB40601G501700)	Poor	Poor	Good	Poor by 2015*
* Disproportionate burdens				

8.7.24 As shown in Table 8.7, the Chalk underlying the study area is designated as Principal Aquifer by the Environment Agency and the Thanet Formation is designated as a Secondary A Aquifer. These designations indicate high groundwater sensitivity. The Principal Aquifer has been assigned a very high importance following the assessment methodology set out in Section 8.4.

8.7.25 Regional groundwater flow direction is northwards towards the River Thames, although this may be affected by groundwater abstractions locally. The White Chalk Subgroup is characterised by a dual permeability system with fracture flow dominating and the matrix providing additional storage in the aquifer.

8.7.26 No site-specific groundwater level information is available. However, groundwater levels are monitored at four Environment Agency observation boreholes within 5 km of the study area. In addition, water levels are monitored in the nearby Southern Water abstraction borehole at Danaway. The data provided by the Environment Agency and Southern Water has been summarised in Table 8.9.

Table 8.9: Groundwater levels

Borehole	Location	Groundwater levels mAOD		
		May 2018	Min (between May 2008 and May 2018)	Max (between May 2008 and May 2018)
Oad Street OBH	c.1km to the east of M2 Jn5	21.89	19.66	27.95
Chestnut Street OBH	c. 1.8km to the northeast of M2 Jn5	12.38	9.53	19.59
White Gates Fm OBH	c. 3.6km to the	8.54	7.80	24.74

Borehole	Location	Groundwater levels mAOD		
		May 2018	Min (between May 2008 and May 2018)	Max (between May 2008 and May 2018)
	northwest of M2 Jn5.			
Riddles Lane OBH	c. 3.7km to the east of M2 Jn5.	19.70	14.92	25.92
Danaway ABH	c. 1km to the northeast of M2 Jn5.	2.42*	-21.45*	20.88
* Groundwater level influenced by pumping in the borehole				

8.7.27 Groundwater quality is further assessed as part of Chapter 10 Geology and Soils.

Groundwater abstractions

8.7.28 The Environment Agency have confirmed that there are two current groundwater abstraction licences within 1 km of the Scheme. Both are used for public water supply. Details of these are presented in Table 8.10. The abstractions each have an associated SPZ1, shown in Figure 8.1 in Volume 3.

Table 8.10: Groundwater abstractions

Licence number	Licence holder	Purpose	National grid reference	Maximum annual quantity (m^3)	Maximum daily quantity (m^3)
9/40/02/0237/G	Southern Water	Public Water Supply	For security reasons, NGRs for PWS cannot be provided.	14963000	68000
9/40/02/0304/G	South East Water	Public Water Supply		1241000	5000

Groundwater discharges

8.7.29 Environment Agency data indicates that there are eight current groundwater discharge permits within the study area. These are detailed in Table 8.11. With the exception of Stockbury WTW (permit reference EPREB3091WN), the discharges are associated with domestic properties.

8.7.30 The current WFD status of the groundwater body is based upon existing levels of discharges. The discharges do not affect the value of any of the water features within the study area.

Table 8.11: Groundwater discharges

Permit reference	Discharge type	Receiving environment	Issue Date	Easting	Northing
P20937	Domestic property (single) (incl. farm house)	Underground strata	19/09/2006	583893	161877
P20786	Domestic property (single) (incl. farm house)	Land	26/10/2005	587181	162542
EPREB3091WN	WTW/Water Collection/ Treatment/Supply	Groundwater via infill system	23/06/2016	584864	161040
P04067	Domestic property (multiple) (incl. farm houses)	Groundwaters via a soakaway	21/12/2012	584000	161630
EPRYP3827GR	Domestic property (multiple) (incl. farm houses)	Groundwater via borehole	03/01/2013	584016	161618
EPRZB3234AW	Domestic property (multiple) (incl. farm houses)	Groundwater	31/07/2013	586558	162325
P00054	Domestic property (single) (incl. farm house)	Into Land	08/07/1985	584100	161850
P04069	Domestic property (multiple) (incl. farm houses)	Into Land	21/12/2012	584010	161850

Source protection zones

8.7.31 There are two Source Protection Zones (SPZ) within the study area (shown in Figure 8.1 in Volume 3). The northern part of the Scheme boundary is within a SPZ1 and much of the study area is within SPZ2 and SPZ3. SPZs are defined around large and public potable groundwater abstraction sites. They provide a visual representation of the increased risks as you get closer to the abstraction. SPZ1 (Inner Protection Zone) is defined by a travel time of 50-days[209] or less from any point within the zone at, or below, the water table. Additionally, the zone has, as a minimum, a 50 m radius. SPZ2: (Outer Protection Zone) is defined by the 400-day[210] travel time from a point below the water table. Additionally, this zone has a minimum radius of 250 or 500 m, depending on the size of the abstraction. The travel time is derived from consideration of the minimum time required to provide delay, dilution and attenuation of slowly degrading pollutants (data.gov. November 2018).

[209] The 50 day travel time is the time from any point below the water table to the source. This zone has a minimum radius of 50 metres.
[210] The 400 day travel time is defined by a 400 day travel time from a point below the water table.

Designated sites

8.7.32 No statutory designations with water dependency have been identified within the study area. Statutory designation will therefore not be considered further in this assessment.

Receptor importance

8.7.33 Receptor importance has been evaluated on the basis of the baseline data presented above, using the criteria set out in Table 8.4.

Table 8.12: Importance of water environment features

Receptor	Rationale	Importance
Surface water ditch system	The ditch system is not illustrated on Ordnance Survey mapping and will need further identification during survey work. It is assumed this does not connect to the wider network at the time of reporting.	Low
Surface water abstractions	The Environment Agency has confirmed that there are no current surface water abstraction licences within 1 km of the Scheme.	N/A
Surface water discharges	The Environment Agency has confirmed (see Appendix E.1 in Volume 2) that there are no current surface water discharges within 1 km of the Scheme.	N/A
Fluvial Floodplain	The Environment Agency has confirmed the mapped Flood Zone 3 is incorrect and the site falls within Flood Zone 1.	Low
Surface water flooding	The A249 within the study area has been classified with a ‘very high’ flood hotspot status.	Very high
Groundwater flooding	The Scheme is located in an area which has a limited potential for groundwater flooding to occur.	Low
Groundwater in Bedrock Principal Aquifer	Public water supply from groundwater abstractions and SPZ1 designated areas.	Very High
Groundwater in Bedrock Secondary A Aquifer	No licensed groundwater abstractions. Where present, overlies the Chalk Principal Aquifer. In hydraulic continuity with the Chalk Principal Aquifer and therefore any potential contamination could be transferred.	High
Groundwater in Superficial Deposits: Secondary Undifferentiated	No licensed groundwater abstractions. Where present, overlies the Chalk Principal Aquifer and likely to have some hydraulic continuity with the Chalk Principal Aquifer. Any potential contamination could be transferred.	High
Designated sites	No statutory designations with water dependency have been identified within the study area.	N/A

Future Baseline

8.7.34 No changes to the current baseline are predicted prior to construction or operation of the Scheme.

8.8 Potential impacts

8.8.1 The potential impacts of the Scheme during construction and operation are discussed in this section.

Construction

Surface water

8.8.2 As identified in the baseline, the status of a ditch system within the study area is unknown at the time of reporting and will need further identification during survey work. Once the presence and status of this feature are known, the impacts will be better understood.

8.8.3 No impacts to other surface waters are anticipated as the baseline demonstrates no surface water receptors are present within the study area. The Scheme will not influence surface water quantity or quality beyond the 1 km study area such that it would have any indirect hydrological impacts to other dependent features outside the 1 km study area.

Flood risk

8.8.4 The storage of materials and temporary impermeable areas at site compounds may result in an increase in flood risk to the Scheme itself and surrounding land. Discharge of abstracted water during construction may also give rise to increased flood risk, especially if discharged to smaller watercourses.

Groundwater

8.8.5 Temporary impacts during construction have the potential to affect the water environment through (but not limited to) the following:

- Increased sediment loads caused by site run-off containing elevated suspended sediment levels. This can result from land clearance, excavation, dewatering of excavations, stockpiles, wheel washings and movement of materials to and from the site. Increased sedimentation has the potential to impact the quality of surface water run-off with the potential to impact the underlying aquifer and groundwater resources;
- Accidental leaks of hazardous materials, particularly concrete and cement products, which can be contained in uncontrolled wash-down water and surface water run-off and has the potential to impact the underlying aquifer and groundwater resources;
- The release of hydrocarbons and oils due to site traffic accessing the site, leakage from oil/fuel storage tanks and accidental spillages which could impact the underlying aquifer and the quality of groundwater resources;
- Deep excavations and piling which can pose a potential contamination risk to the underlying aquifer by providing a rapid pathway for surface run-off to enter the aquifer; and
- Localised dewatering (if required) may potentially impact the underlying aquifer by altering groundwater flow pathways and where water is discharged to ground, it may contain additional sediment and/or increased

turbidity which has the potential to impact the underlying aquifer and groundwater resources.

WFD

8.8.6 WFD effects would include the same potential effects as for groundwater. In addition, if localised dewatering is required, disposal of pumped water to surface water must be undertaken in accordance with the discharge consent, preventing excess sediment or contaminants entering surface.

Operation

Surface water

8.8.7 As highlighted above, the status of a ditch system within the study area is unknown at the time of reporting and will need further identification during survey work. Once the presence and status of this feature are known, the impacts will be better understood.

8.8.8 No impacts to surface water are anticipated as the baseline demonstrates no surface water receptors are present within the study area.

Flood risk

8.8.9 Any new development has the potential to impact on surface water flow paths and therefore flood risk. The Scheme involves additional roads and modifications to existing roads and balancing ponds, which will involve changing the ground levels in areas of surface water flood risk.

8.8.10 Where Scheme elements coincide with areas of existing surface water flood risk, these may lead to an increased risk of flooding or new areas at risk of flooding.

Groundwater

8.8.11 During operation, roads are designed to drain freely to prevent build-up of standing water on the carriageway whilst avoiding exposure to or causing flooding. Contaminants deposited on the road surface are quickly washed off during rainfall events and if there is an identifiable pathway (through the soil) this could threaten groundwater.

8.8.12 On all roads, there is also a risk that a spillage may lead to an acute pollution incident. Where spillages do reach groundwater, the pollution impact can be long lasting and difficult, if not impossible, to remediate (HD 45/09).

8.8.13 Deep foundations may create rapid vertical flow pathways into groundwater and may form a barrier to groundwater flow, potentially reducing groundwater contributions to adjacent water courses and any groundwater abstractions in the water body.

WFD

8.8.14 The WFD groundwater body (the Chalk Principal Aquifer) is at outcrop under the study area, with no low permeability superficial deposits protecting the groundwater. There is potential for surface water run-off to cause deterioration of the groundwater quality if contaminated, potentially impacting WFD status and/or public water supply abstraction quality.

8.9 Design, mitigation and enhancement measures

Construction mitigation

Surface water

8.9.1 As identified in the impacts section, the status of a ditch system within the study area is unknown at the time of reporting and will need further identification during survey work. Once the presence and status of this feature are known, the impacts will be better understood and thus the level of mitigation required.

8.9.2 No impacts to surface water are anticipated as the baseline demonstrates no surface water receptors are present within the study area.

Flood risk

8.9.3 For construction work which has drainage implications, the proposed drainage system will comply with the National Standards, such as Schedule 3 under the Flood and Water Management Act 2010. In addition, any planning obligations (unknown at the time of reporting) will need to make provision for the adoption and maintenance of any Sustainable urban Drainage Systems (SuDs), including any necessary access rights to property.

8.9.4 Floodplain working will be minimised as far as possible – consultation with the LLFAs will be ongoing to ensure sustainable drainage mitigation is incorporated into the design so as to not increase surface water flood risk.

8.9.5 Where subsurface works are required, depending on the groundwater levels at the time of construction, localised dewatering may be required. No works are planned which would increase the groundwater flood risk.

Groundwater

8.9.6 The risk of pollution during construction can be reduced by the adoption of good working practices. Although now withdrawn by the Environment Agency, their Pollution Prevention Guidelines[211] still detail good practice advice for undertaking works which may have the potential to result in water pollution. In general terms, by following these guidelines, significant impacts to the water environment should be avoided.

8.9.7 Pollution prevention measures will be included within the Outline Environmental Management Plan (OEMP) to mitigate the potential impact on the quality of the groundwater resources.

8.9.8 Areas which may generate contaminated water, such as oil storage areas, must be bunded and have water discharged to self-contained units with treatment facilities.

[211] Pollution Prevention Guidelines (PPGs) with particular reference to PPG1 (general guide to the prevention of water pollution), PPG3 (use and design of oil separators in surface water drainage systems), PPG5 (works near or liable to affect watercourses) and PPG6 (working at construction and demolition sites). The PPGs contain a mix of regulatory requirements and good practice advice. They have been withdrawn by the Environment Agency but are still considered good practice advice to avoid pollution of watercourses. All of the PPGs are available from http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/business/topics/pollution/39083.aspx

8.9.9 Run-off from the site will be managed and there will be no discharge to groundwater within SPZ1.

8.9.10 Where deep foundations are intended to be part of the Scheme, these should be designed in accordance with industry standards – taking into account the site-specific water level and flow monitoring data obtained from intrusive ground investigation for the Scheme.

8.9.11 A piling risk assessment should be carried out to ensure the selected piling method does not introduce contamination pathways into the aquifer. Piling design should include mitigation in the form of substantial clear spacing between piles and appropriate piling installation methods.

WFD

8.9.12 WFD construction mitigation would include the same as outlined for groundwater.

Operation mitigation

8.9.13 Mitigation measures during operation are required for several reasons:

- To treat contaminants in normal road run-off;
- To deal with any accidental spillages occurring on the carriageway;
- To prevent any increase to flood risk in the area; and
- To protect and enhance wildlife corridors near watercourses.

8.9.14 The design of the drainage system would comply with all current standards and SuDS best practice techniques to ensure that sustainability is a key drainage design criterion.

8.9.15 The drainage design for the upgraded and new carriageway sections will consist of gravity drainage networks, which will convey flows to suitable outfalls.

8.9.16 Any proposed soakaways require a pollution control valve in upstream manholes with appropriate access to enable the systems to be closed off in the event of a spillage.

8.9.17 The following paragraphs provide additional information on the mitigation proposals. Further detail can also be found in the flood risk assessment and drainage strategy (Appendix E.2 and E.4 in Volume 2).

Surface water

8.9.18 As identified in the impacts section, the status of a ditch system within the study area is unknown at the time of reporting and will need further identification during survey work. Once the presence and status of this feature are known, the impacts will be better understood and thus the level of mitigation required.

8.9.19 No impacts to surface water are anticipated as the baseline demonstrates no surface water receptors are present within the study area.

Flood risk

8.9.20 The drainage design for the Scheme will manage the flood risk to the upgraded and new carriageway and will control discharges to outfall locations to ensure no adverse impact on flood risk.

8.9.21 The Scheme will modify the surface water overland flow paths. This affects flood levels adjacent to the Vale Cottages properties, but the flood levels are significantly lower than the threshold levels for these properties, therefore no mitigation is proposed.

8.9.22 The Gate House property that currently is at risk of flooding will be purchased as part of the Scheme and therefore not a consideration for mitigation.

8.9.23 The Flood Risk Assessment (Appendix E.2 in Volume 2) provides details of the surface water flooding.

Groundwater

8.9.24 The development of the drainage within and nearby SPZs within the study area has been discussed with the Environment Agency, and are as follows:

- It is not acceptable for any highway run-off to be discharged to ground within SPZ1. Discharge to ground in SPZ2 and SPZ3 can take place, subject to appropriate assessment of anticipated pollutant levels, proposed treatment and resultant water quality; and
- Mapped SPZs are a planning guide and not to be taken as exact boundary lines. Therefore, effort must be made not to discharge to ground for some distance from the SPZ1 boundary.

8.9.25 As demonstrated in the proposed road drainage catchment table, Table 8.13 drainage is to ground.

8.9.26 As identified in the baseline, the groundwater sensitivity of the study area is very high owing to the Scheme being underlain by a Principal Aquifer and the presence of SPZs. Therefore, the drainage design includes pollution control measures on drainage to ground that is part of the Scheme. The drainage design has been developed in parallel to discussions with the Environment Agency to ensure the design meets regulatory requirements.

8.9.27 With the limited survey information available to inform the drainage design at the time of reporting, the strategy will be based on the following principles:

- The proposed infiltration basins and soakaways features are located outside of SPZ1. No highway run-off is being discharged to ground within SPZ1. The highway drainage within the SPZ1 area will be discharged to the existing drainage system, which is understood to take flows away from SPZ1 and discharge to ground to the northeast (outside the SPZ1);
- Soakaways have the following advantages (Susdrain, 2018):
  - They provide storm water attenuation, storm water treatment and groundwater recharge; and

- Good water quality treatment performance through the physical filtration to remove solids, and biochemical reactions involving micro-organisms growing on the fill or in the soil.

8.9.28 All infiltration basins and soakaways proposed will have pollution control valves to enable them to be shut off in the event of a spillage.

Table 8.13: Road drainage catchments and proposed mitigation

Catchment reference	Receptor	Proposed mitigation	Total impermeable area (ha)	Total permeable area (ha)
CA-1	Groundwater	Infiltration basin 1 Pollution control valves	3.32	1.22
CA-2	Groundwater	Infiltration basin 2 Pollution control valves	1.18	0.42
CA-3	Groundwater	Infiltration basin 3 Pollution control valves	1.12	0.48
CA-4	Groundwater	Infiltration basin 4 Pollution control valves	0.63	0.47
CA-5	Groundwater	Infiltration basin 5 Pollution control valves	2.42	0.78
CA-6	Groundwater	Soakaway trench Pollution control valves	0.33	0.17
CA-7	Groundwater	Assumed infiltration basin Pollution control valves	1.38	0.35
CA-8A	Groundwater	Soakaway trench Pollution control valves	0.34	0.10
CA-8B	Groundwater	Infiltration basin 6 Pollution control valves	0.73	0.31

WFD

8.9.29 The WFD assessment (Appendix E.3 in Volume 2) assumes that the mitigation measures outlined below will continue to be embedded into the design:

- Piling risk assessments will be undertaken for intrusive works to ensure that there will be no impact (any potential impact identified would result in an amended approach to piling);
- Piling design will include mitigation in the form of substantial clear spacing between piles and appropriate piling installation methods;
- Pollution control measures will be installed on all road run-off soakaway drainage to ground. These will most likely take the form of pollution control valves in chambers near outfalls, and potentially oil interceptors;
- Road run-off drainage systems will be designed in accordance with modern toxicity standards derived through application of HAWRAT; and
- Intrusive site investigation will be undertaken to determine site-specific

depth to water table and groundwater flow direction. These investigations may highlight where mitigation is required.

8.10 Assessment of effects

Significant effects

8.10.1 This section describes the significant effects following the implementation of avoidance and mitigation measures. Full details are provided in Table 8.15.

Construction

Surface water

8.10.2 No impacts to surface water are anticipated as the baseline demonstrates no surface water receptors are present within the study area.

Flood risk

8.10.3 For fluvial flood risk, there are no works within the Scheme boundary that lie within Flood Zone 2 or 3.

8.10.4 The importance for surface water flooding has been classed as high. The Vale Cottages are adjacent to an area of surface water flooding, however the extreme flood levels (1 in 100 annual probability including climate change) are below the threshold levels. Flooding within garages of the cottages has been reported. The change in flood levels at the properties is between 10 mm and 50 mm, therefore the impact is considered minor. Because the surface water flooding does not risk internal property flooding, the overall significance of effect is slight. Therefore, there will be no significant effects.

8.10.5 Where subsurface works are required, depending on the groundwater levels at the time of construction, localised dewatering may be required. No temporary discharge to ground is planned, which would increase the groundwater flood risk.

Groundwater

8.10.6 Likely impacts from road construction activities can be mitigated through industry standard design principles and good working practices.

8.10.7 For groundwater receptors, based on a very high importance and negligible scale of impact, subject to the correct implementation of all mitigation measures, the overall effect on groundwater has been assessed as neutral which is not considered significant.

8.10.8 The assessment shows that there will be no anticipated temporary significant effects on licensed abstractions or consented discharges during construction.

WFD

8.10.9 The WFD assessment (Appendix E.3 in Volume 2) concludes that, subject to the correct implementation of all mitigation measures, temporary construction activities are not expected to have an adverse effect on the North Kent Swale Chalk groundwater body. As noted above, for groundwater receptors, subject to

the correct implementation of all mitigation measures, the overall effect on groundwater has been assessed as neutral, which is not considered significant.

Operation

Surface water

8.10.10 No impacts to surface water are anticipated as the baseline demonstrates no surface water receptors are present within the study area.

Flood risk

8.10.11 There are no works within the Scheme boundary that lie within Flood Zone 2 or 3. Nor is there a risk from groundwater flooding, therefore there will be no significant effects relating to these sources of flooding.

8.10.12 The importance for surface water flooding has been classed as high. The Vale Cottages are adjacent to an area of surface water flooding, however the extreme flood levels (1 in 100 annual probability including climate change) are below the threshold levels. Flooding within garages of the cottages has been reported. The change in flood levels at the properties is between 10 mm and 50 mm, therefore the impact is considered minor. Since the surface water flooding does not risk internal property flooding, the overall significance of effect is slight. Therefore, there will be no significant effects.

8.10.13 There is no record of historic groundwater flooding in the area and the data within the Strategic Flood Risk Assessments indicates the risk is low. There are no significant works proposed below ground level that could affect the level of groundwater flood risk. The risk from groundwater flooding is low.

Groundwater

8.10.14 In accordance with the DMRB (HD 45/09), a Method C test, has been used to assess the impacts of road drainage on groundwater quality. The assessment identified a medium risk to groundwater (as demonstrated in Table 8.14).

Table 8.14: Assessment of pollution impacts from routine run-off on groundwater

Component no.	Property	Weighting factor	Scheme data	Risk score[1]	Component score [1]
1	Traffic density	15	≥50,000 - 100,000	Medium (2)	30
2	Rainfall volume	15	<740	Low (1)	15
	Rainfall intensity		Concentrated (>47 mm FEH 1 hour rainfall)	High (3)	45
3	Soakaway geometry	15	Single point, or shallow soakaway	Medium (2)	30

Component no.	Property	Weighting factor	Scheme data	Risk score[1]	Component score [1]
4	Unsaturated zone	20	Depth to water table >15m	Low (1)	15
5	Flow type	20	Sedimentary deposits	High (3)	60
6	Effective grain size	7.5	Very coarse sand and above	High (3)	22.5
7	Lithology	7.5	<1% clay minerals	High (3)	22.5
Cumulative Score					238
Medium risk of Impact					
Key: 1 = Score is weighting factor multiplied by the risk score (x)					

8.10.15 In conjunction with HD 45/09, the simple index approach outlined in the CIRIA SuDS Manual (C753) was also undertaken and provided guidance in the selection of mitigation.

8.10.16 The pollution hazard level for the trunk roads and motorways are high (based on Table 26.2 of C753) and can be mitigated through provision of bio-retention systems (in accordance with Table 26.4 of C753). However, Clause 18.2 of C753 states that bioretention systems are generally applied for catchment areas of less than 0.8 hectare. Therefore, for catchments CA-4, CA-6, CA-8a and CA-8b, where the catchment areas are less than 0.8ha, there will be an opportunity to re-evaluate the design of the infiltration basins for them to include vegetation and specific types of filter material (for them to become bio-retention systems), when infiltration rates have been confirmed and there is confidence in the system's performance.

8.10.17 Given the pathway to groundwater demonstrated by Method C is a medium risk, Method A of the HD 45/09 (using HAWRAT) was also undertaken. This considered the pollution concentrations of copper and zinc within road run-off discharging to ground. The EQS component of Method A was only considered as the RSTs and suspended sediment impacts are not deemed relevant when in the context of discharge to ground.

8.10.18 Method A tests show the level of impact for all catchments is negligible with neutral significance of effect, as demonstrated in Table 8.15.

8.10.19 In accordance with HD 45/09, the assessment of pollution impacts from spillages (Method D) has been undertaken. The probability of a spillage with an associated risk of serious pollution incident occurring was found to be less than 1%, as demonstrated in Table 8.15. However, given the sensitive nature of the groundwater within the study area and the advice from the Environment Agency, the infiltration basins and soakaways proposed will have pollution control valves to enable them to be shut off in the event of a spillage.

8.10.20 For groundwater receptors, based on a very high importance and negligible scale of impact, subject to the correct implementation of all mitigation measures,

the overall effect on groundwater has been assessed as neutral, which is not considered significant.

8.10.21 The assessment shows that there will be no anticipated significant effects on licensed abstractions or consented discharges during operation.

Table 8.15: Assessment of operational pollution impacts from routine run-off and spillage risk on groundwater

Road drainage catchments	Receiving watercourse	EQS (µg/l) (Method A)		Groundwater quality impact (Method A)		Method C	Spillage risk (Method D)	Spillage risk impact (Method D)	
		Copper (10ug/ml)	Zinc (7.8ug/ml)	Magnitude of impact*	Significance of effect*		Residual return period with proposed pollution reduction measures	Magnitude of impact**	Significance of effect**
CA-1	Groundwater	1.39	3.37	Negligible	Neutral / insignificant	Medium risk	3806	Negligible	Neutral / insignificant
CA-2	Groundwater	0.71	1.74	Negligible	Neutral / insignificant	Medium risk	21870	Negligible	Neutral / insignificant
CA-3	Groundwater	0.68	1.67	Negligible	Neutral / insignificant	Medium risk	1798	Negligible	Neutral / insignificant
CA-4	Groundwater	0.43	1.06	Negligible	Neutral / insignificant	Medium risk	13945	Negligible	Neutral / insignificant
CA-5	Groundwater	1.16	2.81	Negligible	Neutral / insignificant	Medium risk	3002	Negligible	Neutral / insignificant
CA-6	Groundwater	0.25	0.63	Negligible	Neutral / insignificant	Medium risk	11582	Negligible	Neutral / insignificant
CA-7	Groundwater	0.80	1.96	Negligible	Neutral / insignificant	Medium risk	4699	Negligible	Neutral / insignificant
CA-8A	Groundwater	0.26	0.65	Negligible	Neutral / insignificant	Medium risk	17605	Negligible	Neutral / insignificant
CA-8B	Groundwater	0.49	1.21	Negligible	Neutral / insignificant	Medium risk	8982	Negligible	Neutral / insignificant

* As per HD33/16 guidance (table 8.1 in HD 33/16) there is not any removal efficiencies for infiltration basins / discharge to ground for the removal of soluble pollutants. This magnitude and associated signifies is without any mitigation. ** With mitigation.

WFD

8.10.22 The WFD assessment (Appendix E.3 in Volume 2) shows Scheme components including those forming part of the road drainage network, will not cause an impact to the North Kent Swale Chalk at the waterbody scale during operation, subject to the correct implementation of all mitigation measures. As noted above, for groundwater receptors, subject to the correct implementation of all mitigation measures, the overall effect on groundwater during operation has been assessed as neutral, which is not considered significant.

Residual effects

Surface water

8.10.23 No effects to surface water are anticipated as the baseline demonstrates no surface water receptors are present within the study area.

Flood risk

8.10.24 No residual effects to flood risk are anticipated.

Groundwater

8.10.25 Subject to the correct implementation of all mitigation measures, the overall residual effect on groundwater has been assessed as neutral, which is not considered significant.

WFD

8.10.26 The WFD assessment (Appendix E.3 in Volume 2) shows no residual effects subject to correct implementation of all mitigation measures.

8.11 Cumulative effects

8.11.1 Cumulative effects can be intra-Scheme, for example the combined impact of multiple drainage outfalls discharging into a single receptor (i.e. groundwater and also inter-Scheme) where more than one scheme is under construction that has potential to impact on the same receptor.

8.11.2 For the assessment of impacts associated with soluble pollutants (specifically zinc and copper), where outfalls for catchments are within 1 km of one another and discharge to the same water body receptor, these were aggregated for assessment following guidance for the use of HAWRAT in HD45/09.

8.11.3 All catchments discharge to groundwater, therefore a cumulative assessment of the combined discharge from each outfall was undertaken. As demonstrated in Table 8.16, results show the combined discharge from all catchments is negligible impact with neutral significance of effect.

Table 8.16: Cumulative operational effects

Road drainage catch-ments	Receiving water-course	EQS (µg/l) (Method A)		Groundwater quality impact (Method A)		Method C	Spillage risk (Method D)	Spillage risk impact (Method D)	
		Copper (10ug/ml)	Zinc (7.8ug/ml)	Magnitude of impact*	Significance of effect*		Residual return period with proposed pollution reduction measures	Magnitude of impact**	Significance of effect**
All catchments CA-1 - CA-8B (inclusive)	Groundwater	2.47	5.96	Negligible	Neutral / insignificant	Medium risk	662	Negligible	Neutral / insignificant

8.11.4 Typically, new developments increase impermeable areas and run-off. They can potentially cause drainage pathways to be altered and can provide an increased source of pollution to shared water receptors. For developments within the study area, shown on Figure 15.1 in Volume 3, drainage strategies should be in place or proposed for these developments.

8.11.5 These separate drainage systems should accommodate their own temporary drainage requirements during the construction phases and appropriate mitigation that should ensure minimal impacts to water through construction and operational phases. It is therefore concluded that there would be no significant adverse cumulative effects during construction or operation.

8.12 Monitoring

8.12.1 To ensure mitigation measures are properly implemented, it is essential there is effective environmental management throughout the construction, operation and aftercare of the Scheme.

8.12.2 The Outline Environmental Management Plan (OEMP) will form the basis for environmental management of the Scheme. It will ensure that environmental issues are properly addressed initially through the construction phase and establishes the basis for ensuring environmental issues and commitments are dealt with during the operation and aftercare of the Scheme.

8.13 Summary

8.13.1 The spatial scope of the assessment has included features of the water environment within 1 km of the Scheme.

8.13.2 The assessment has considered the impacts (both construction and operation) on water quality (both surface and groundwater), flood risk through the means of an FRA (Appendix E.2 in Volume 2) and the compliance with the WFD (Appendix E.3 in Volume 2).

8.13.3 Key water environment receptors/characters within the study area include:

- Flood Zone 1 area;
- Surface water flooding areas;
- The Kent North Swale Chalk WFD groundwater body; and
- Principal Aquifer, Secondary A Aquifer, Secondary (Undifferentiated) Aquifer.

8.13.4 The assessment shows that, subject to the correct implementation of all mitigation measures, there will be no significant temporary adverse effects on surface water, WFD compliance, groundwater or fluvial and surface water flood risk during the construction period.

8.13.5 No impacts to surface water are anticipated during operation of the Scheme as the baseline demonstrates no surface water receptors are present within the study area.

8.13.6 The groundwater risk assessment concludes there will be no significant adverse effects on groundwater during the operation of the Scheme. The effects from the

Scheme on groundwater are assessed as negligible impact with neutral significance.

8.13.7 The FRA concludes that there will be no significant adverse effects on flood risk.

8.13.8 The WFD assessment (Appendix E.3 in Volume 2) concludes none of the Scheme components are considered to cause deterioration at the water body scale (thus passing Test A) and should not prevent future attainment water body status (Test B). Critically, this assumes that mitigation appropriate to each Scheme component will be 'embedded' into later phases of the design.

8.13.9 The cumulative assessments results show negligible impact with neutral significance of effect for both within Scheme (intra-related) and external developments (inter-related).

9. Landscape and Visual

9.1 Introduction

9.1.1 This chapter assesses the potential landscape and visual effects resulting from the construction and operation of the Scheme and describes the likely significant effects on the landscape character and on people's views and visual amenity.

9.1.2 'Landscape' and 'visual' are two distinct, but related sub-topics. 'Landscape' takes its character from the interaction of natural and/or human factors, including: landform, watercourses, land use, built-form, land cover/vegetation, and cultural/heritage influences. The pattern of landscape elements and features can vary considerably and this is a key component that makes one area distinctive from another within a given area. The assessment of landscape effects addresses potential direct changes to landscape features and direct/indirect changes to the aesthetic and perceptual qualities of the landscape.

9.1.3 'Visual', in the context of this assessment, refers to the nature and quality (or visual amenity value) of available views in a landscape, as experienced by people, which can be a key influence upon their quality of life. The assessment of visual effects addresses potential changes in the quality and amenity value of existing views as a result of the change, or loss, of existing landscape elements, and/or the introduction of new elements, taking into account the extent to which the Scheme would be visible from visual receptors.

9.1.4 Key issues, impacts and effects considered within this chapter include the following:

- Direct effects resulting from permanent and temporary, long- and short-term (construction period) physical changes to the landscape in terms of landform, land use (along the transport corridor), fragmentation of landscape features or designated areas, vegetation changes and the introduction of moving traffic;
- Indirect effects on the character and quality of the landscape in terms of encroachment, or effects on the landscape setting of features and areas, disturbance to sense of place and changes in the perception of the landscape through the introduction of features alien or discordant to the character of the landscape;
- Direct day and assumed night-time effects on the visual amenity of visual receptors, in terms of changes in views and their composition for residents and people visiting the area; and
- Indirect effects on visual receptors in different places, in terms of an altered visual perception, leading to changes in public attitude, behaviour and how people value or use a place.

9.1.5 Through applying professional judgement in line with the Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA 3)[212], the sensitivity and magnitude of impact for each receptor has been combined to give

[212] Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA 3), 2013.

a level of effect and a conclusion has been drawn in each case, as to whether the effects are significant or not.

9.1.6 Mitigation has been addressed as part of an iterative design and assessment process. The design approach is described in Section 9.9 and Section F.4 of Appendix F in Volume 2. Additional information to support this chapter is presented in Appendix F in Volume 2 and in the following Figures in Volume 3:

- Figure 2.1 Environmental Constraints Plan;
- Figure 2.3 Preliminary Environmental Design & Preliminary Planting Lists;
- Figure 2.4 Cross Sections;
- Figure 9.1 Local Designations and Public Rights of Way;
- Figure 9.2 National and Regional Landscape Character Areas;
- Figure 9.3 Local Landscape Character Areas;
- Figure 9.4 Topography;
- Figure 9.5 Key Visual Receptor Locations;
- Figure 9.6 VP Locations Plan Stage 2;
- Figure 9.7 and 9.14 VP Locations Plan Stage 3;
- Figure 9.8 Dark Skies Map;
- Figure 9.9 Tranquillity Map;
- Figure 9.10 Not Used;
- Figure 9.11 Zone of Visual Influence (ZVI) Baseline;
- Figure 9.12 Zone of Visual Influence (ZVI) Year 1;
- Figure 9.13 Zone of Visual Influence (ZVI) Year 15;
- Figures 9.15 – 9.46 Photo sheets;
- Figures 9.47 – 9.50 Visual effects drawings (Year 1 / Year 15); and
- Figures 9.51 – 9.59 Photomontages (Year 1 / Year 5 and Year 15).

9.2 Competent expert evidence

9.2.1 The Landscape and Visual Impact Assessment (LVIA) was carried out through a combination of desk study review and field work during 2018. The LVIA was undertaken by Elizabeth Dickie, a Chartered Landscape Architect (CMLI), with a BA Hons and PGDip. in Landscape Architecture, moderated by Martin Byrne, a Senior Chartered Landscape Architect with a combined value of 20 years' experience.

9.3 Legislative and policy framework

9.3.1 A framework of international, national and local legislation/planning policy guidance exists to protect and conserve the landscape. Table 9.1 below outlines the relevant local planning policy documents applicable to the study area.

9.3.2 Common themes exist throughout the policy documents and legislation, including the importance of Areas of Outstanding Natural Beauty (AONBs) and the weight attributed to the need to conserve, enhance and protect these valuable national landscapes.

Table 9.1: Legislation, regulatory and policy framework for landscape and visual

Scale	Legislation/ regulation	Summary of requirements/relevant policies
International	Council of Europe: European Landscape Convention (ELC), Florence, 2000[213].	Sets out an internationally agreed definition of landscape: “The landscape is part of the land, as perceived by local people or visitors, which evolves through time as a result of being acted upon by natural forces and human beings”. It also sets out the key actions that countries should follow and provides an integrated, holistic approach and international context for landscape, under the headline banner that "All Landscapes Matter".
National	The National Parks and Access to the Countryside Act, 1949[214].	Enabled the creation of the National Parks and ensures that our most beautiful, valued and unique landscapes have been and will continue to be protected in the future. The purpose of the National Park is to conserve and enhance natural beauty, wildlife, cultural heritage and to promote opportunities for the understanding and enjoyment of the special qualities of the National Parks by the public. As per Section 11A: ‘It is the duty of certain bodies and persons to have regards to the purposes for which National Parks are designated’. ‘The National Park Authority shall seek to foster the economic and social well-being of local communities within the National Park and shall for that purpose co-operate with local authorities and public bodies whose functions include the promotion of economic or social development within the area of the National Park’. ‘In exercising or performing any functions in relation to, or so as to affect land in a National Park, any relevant authority shall have regard to this Act and, if it appears that there is a conflict between these purposes, shall attach greater weight to the purpose of conserving and enhancing the natural beauty, wildlife and cultural heritage of the area comprised in the National Park’.
	The Wildlife and Countryside Act, 1981[215].	Gives protection to native species, controls the release of non-native species, enhances the protection of Sites of Special Scientific Interest (SSSI) and builds upon the rights of way rules in the National Parks and Access to the Countryside Act 1949. This act states that: ‘References to the conservation of the natural beauty of any land shall be construed as including references to the conservation of its flora, fauna and geographical and physiographical features’.

[213] Council of Europe: European Landscape Convention (ELC), Florence, 2000.
[214] The National Parks and Access to the Countryside Act, 1949.
[215] The Wildlife and Countryside Act, 1981.

Scale	Legislation/ regulation	Summary of requirements/relevant policies
	Countryside and Rights of Way Act, 2000[216].	Provides the legal framework for Areas of Outstanding Natural Beauty (AONBs) and places a duty on Natural England to provide general advice on development matters. It stipulates a requirement that the appropriate country agency be consulted on development plans, access arrangements and access orders. Provides local authorities with permissive powers to take action to conserve and enhance the natural beauty of the AONBs. With reference to Section 85 – General duty of public bodies etc.: 'In relation to, or so as to affect, land in an area of outstanding natural beauty, a relevant authority shall have regard to the purpose of conserving and enhancing the natural beauty of the area of outstanding natural beauty'.
	The Hedgerows Regulations,1997[217].	The Hedgerow Regulations protect countryside hedgerows and make provision for the protection of important hedgerows in response to concern at the rapid loss of hedgerows in England and Wales.
	National Planning Policy Framework (NPPF), 2019[218].	The NPPF sets out the Government's planning policy for England and how these policies are expected to be applied. Chapter 12 paragraph 127, refers to how planning policy and decisions can achieve well-designed places. Chapter 15 (Conserving and enhancing the natural environment) requires protection and enhancement of valued landscapes, in particular, to those protected by designations, such as Areas of Outstanding Natural Beauty. Whilst Chapter 16 (Conserving and enhancing the historic environment) is also relevant to Landscape and Visual Assessment. Chapter 15 paragraph 170 a)– f) identify ways that planning policies and decisions should contribute to and enhance the natural and local environment. Chapter 15 paragraph 172 also states that 'great weight should be given to conserving and enhancing landscape and scenic beauty in National Parks, the Broads and Areas of Outstanding Natural Beauty, which have the highest status of protection in relation to these issues. The scale and extent of development within these designated areas should be limited. Planning permission should be refused for major development other than in exceptional circumstances, and where it can be demonstrated that the development is in the public interest'. Chapter 15 clarifies that whether a proposal is 'major development' is a matter for the decision maker, taking into account its nature, scale and setting, and whether it could have a significant adverse impact on the purposes for which the area has been designated or defined. Consideration should include an assessment of: 'a) the need for the development, including in terms of

[216] Countryside and Rights of Way Act, 2000.
[217] The Hedgerows Regulations, 1997.
[218] Department for Communities and Local Government (2019). National Planning Policy Framework. London: DCLG.

Scale	Legislation/ regulation	Summary of requirements/relevant policies
		any national considerations, and the impact of permitting it, or refusing it, upon the local economy; b) the cost of, and scope for, developing outside the designated area, or meeting the need for it in some other way; and c) any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated'. The NPPF is supported by Planning Practice Guidance (PPG). The following aspects of PPG are relevant to the consideration of landscape and visual matters: Design: The PPG provides advice on key points to take into account in relation to good design (including the importance of creating distinctive places); and Natural Environment: The PPG provides advice on how the character of landscapes can be assessed to inform planning decisions.
	DEFRA: English National Parks and the Broads – UK Government Vision and Circular, 2010[219].	The purpose of this circular is to provide updated policy guidance on the English National Parks and the Broads, listing a vision for the Parks up to 2030. The vision for the English National Parks and the Broads is as follows: Paragraph 10: 'By 2030 English National Parks and the Broads will be places where: There are thriving, living, working landscapes notable for their natural beauty and cultural heritage'; and Wildlife flourishes and habitats are maintained, restored and expanded and linked effectively to other ecological networks. Woodland cover has increased, and all woodlands are sustainably managed, with the right trees in the right places. Landscapes and habitats are managed to create resilience and enable adaptation.' Paragraph 11 states: 'The Government wishes to see all relevant bodies with an influence on the management of these special areas working towards the achievement of this vision'.
	National Networks National Policy Statement (NN NPS).	The NN NPS provides landscape guidance for development areas (paragraphs 5.150 to 5.153). It requires that great weight is to be given to conserving landscape and scenic beauty in nationally designated areas and that Areas of Outstanding Natural Beauty have the highest status of protection in relation to landscape and scenic beauty and notes a strong presumption against any significant road widening within such areas. Paragraph 5.147 states: 'Any statutory undertaker commissioning or undertaking works in relation to, or so as to affect land in a National Park or Areas of Outstanding Natural Beauty, would need to comply with the respective duties in Section 11A of the National

[219] DEFRA: English National Parks and the Broads – UK Government Vision and Circular, 2010.

Scale	Legislation/ regulation	Summary of requirements/relevant policies
		Parks and Access to Countryside Act 1949 and Section 85 of the Countryside and Rights of Way Act 2000'. Paragraph 5.148 states: 'For significant road widening or the building of new roads in National Parks and the Broads applicants also need to fulfil the requirements set out in Defra's English national parks and the broads: UK government vision and circular 2010 or successor documents. These requirements should also be complied with for significant road widening or the building of new roads in Areas of Outstanding Natural Beauty.' Paragraph 5.149 states: 'Projects need to be designed carefully, taking account of the potential impact on the landscape. Having regard to siting, operational and other relevant constraints, the aim should be to avoid or minimise harm to the landscape, providing reasonable mitigation where possible and appropriate'. Paragraph 5.154 states: 'The duty to have regards to the purposes of nationally designated areas also applies when considering applications for projects outside the boundaries of these areas which may have impacts within them. The aim should be to avoid compromising the purposes of designation and such projects should be designed sensitively given the various siting, operational and other relevant constraints'. Paragraph 5.157 states: 'In taking decisions, the Secretary of State should consider whether the project has been designed carefully, taking account of environmental effects on the landscape and siting, operational and other relevant constraints, to avoid adverse effects on landscape or to minimise harm to the landscape, including by reasonable mitigation.' Paragraph 5.158 states: 'The Secretary of State will have to judge whether the visual effects on sensitive receptors, such as local residents, and other receptors, such as visitors to the local area, outweigh the benefit of the development'. Paragraph 5.160 states: 'Adverse landscape and visual effects may be minimised through appropriate siting of infrastructure, design (including choice of materials), and landscaping schemes, depending on the size and type of proposed project. Materials and designs for infrastructure should always be given careful consideration'.
Regional	Kent Downs AONB Management Plan 2014-2019[220].	The Kent Downs Management Plan has been devised to ensure that the natural beauty and special character of the landscape and vitality of the communities of the Kent Downs are recognised, maintained and strengthened. Sustainable Development Policies: • SD1: Which recognises the need to conserve and enhance the natural beauty of the Kent Downs AONB as the primary purpose of the designation

[220] Kent Downs AONB Management Plan 2014-2019 (Kent Downs Area of Outstanding Natural Beauty, 2014).

Scale	Legislation/ regulation	Summary of requirements/relevant policies
		and directs that the AONB be given the highest level of protection within statutory and other appropriate planning and development strategies and development control decisions; • SD2: States that the local character, qualities and distinctiveness of the Kent Downs AONB will be conserved and enhanced in the design, scale, setting and materials of new development, redevelopment and infrastructure; • SD7: To retain and improve tranquillity, including the experience of dark skies at night, careful design and the use of new technologies should be used. Highways infrastructure which negatively impacts upon the local tranquillity of the Kent Downs AONB will be opposed unless satisfactorily mitigated; • SD8: Which provides that proposals that negatively impact on the distinctive landform, landscape character, special characteristics and qualities, the setting and views to and from the Kent Downs AONB will be opposed unless they can be satisfactorily mitigated; • SD10: Which encourages positive measures to mitigate the negative impact of infrastructure and growth on the natural beauty and amenity of the Kent Downs AONB; • SD11: Where development will take place that will have a negative impact on the landscape character, characteristics and quality of the Kent Downs AONB or its setting, mitigation measures appropriate to the national importance of the Kent Downs landscape must be identified, implemented and maintained. It also prescribes that landscape detractors must be removed or mitigated; and • SD12: Which sets out the expectation that transport and infrastructure schemes will avoid the Kent Downs AONB as far as is practicable. Essential developments will be expected to fit unobtrusively into the landscape, respect landscape character, be mitigated by sympathetic landscape and design measures and provide environmental compensation by benefits to natural beauty elsewhere. Landform and Landscape Policies: • LLC1: Which directs that the protection, conservation and enhancement of special characteristics and qualities, natural beauty and landscape character of the Kent Downs AONB will be supported and pursued; and • LLC5: Which directs that the revision, development and use of co-ordinated landscape character assessments for the Kent Downs AONB will be supported and pursued. Biodiversity Policies: • BD1: Creation of new habitats and habitat corridors will be pursued, informed by landscape character, through collaboration to establish functional

Scale	Legislation/ regulation	Summary of requirements/relevant policies
		ecological networks and high-quality green infrastructure. Farmed landscape Policies: • FL1: The AONB will retain the principally farmed character for which it is valued. Woodland and Trees Policies: • WT1: Threats to the existing extent of woodland and transitional habitats around woodland will be resisted. Extension of both habitat types will be supported where appropriate to landscape character. The loss of Ancient Woodland will be opposed.
Local	Maidstone Borough Local Plan (2017)[221].	Policy SS 1 – Maidstone Borough spatial strategy. Policy SP 17 – The Countryside: • The policy makes direct reference to the conservation and enhancement of the Kent Downs Area of Outstanding Natural Beauty in addition to the preservation of local character and appearance. Policy DM 3 – Natural environment: • Developers will ensure that new development protects and enhances the natural environment by incorporating measures where appropriate. Policy DM 30 – Design principles in the countryside.
	Bearing Fruits 2031 – The Swale Borough Council – Local Plan Adopted July 2017[222].	Policy ST 8 - The Faversham area and Kent Downs strategy. Policy CP 2 – Promoting sustainable transport. Policy CP 4 - Requiring Good Design. Policy CP 8 - Conserving and enhancing the historic environment. Policy DM14 – General development criteria. Policy DM24 – Conserving and Enhancing Valued Landscapes. Policy DM26 – Rural Lanes. Policy DM29 - Woodlands, trees and hedges. Policy DM30 - Enabling development for landscape and biodiversity enhancement. Policy DM34 – Scheduled Monuments and archaeological sites.

Table Source: Various

9.4 Study area

9.4.1 The study area comprises a 2 km radius around the centre of the Scheme and covers the area which it has been deemed that the Scheme may influence significantly. The 2 km circular study area was selected (as opposed to a 2 km buffer corridor) due to the central point of the Scheme (e.g. the highest point of the Stockbury flyover and the lighting poles associated with the Stockbury roundabout configuration) being deemed to have the greatest chance of

[221] Maidstone Borough Local Plan (2017).
[222] Bearing Fruits 2031 – The Swale Borough Council – Local Plan Adopted July 2017.

significant effects on landscape and visual receptors, whilst the northern and southern ends of the Scheme were deemed to have the least chance of significant effects, therefore the emphasis was placed upon a central offset, rather than a corridor buffer. The study area has been assessed and defined through modelling and verification in the field. It is considered, based upon the nature of the Scheme and the current design, that the Scheme would not have significant effects beyond a distance of 2 km.

9.4.2 Verified Zones of Visual Influence (ZVIs) have been devised to demonstrate the theoretical extent that the Scheme is visible from the surrounding landscape and potential visual receptors. The ZVI was produced using GIS data in accordance with the guidelines of the DMRB, taking into account landform and landcover, including built development and vegetation.

9.4.3 Site surveys were then undertaken to verify the ZVI and to assess the views available from publicly accessible locations. Survey work was undertaken from as near to the potentially affected buildings or viewpoints as possible, without trespassing on private land. Specific viewpoint locations include pavements adjacent to residential properties/road and Public Rights of Way (PRoW).

9.4.4 Ordnance Survey (OS) base maps and aerial photography were used to determine where a straight line of sight of the Scheme may be available and therefore indicating potential viewpoint locations, taking into account the topography and any intervening features such as buildings and vegetation.

9.4.5 For comparison purposes, one of the ZVIs has been produced to demonstrate the visibility of the existing site/road extent from the surrounding landscape, and further ZVIs produced to demonstrate the visibility of the Scheme during year 1 (winter) and year 15 (summer). Figures 9.12 and 9.13 in Volume 3, demonstrate that the extent of the ZVI and views of the Scheme are limited to the adopted 2 km study area.

9.4.6 Viewpoint photography undertaken as part of the assessment has not been undertaken from private land/property, therefore professional judgement has been used to assess the potential effect of the Scheme upon visual receptors.

9.4.7 Figure 9.11 in Volume 3, shows the ZVI and viewpoints representing visual receptors whose views are considered likely to be affected by the Scheme.

9.5 Assessment methodology

9.5.1 This LVIA has been undertaken in accordance with the methodology detailed within the Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 5 Landscape Effects[223] the accompanying Interim Advice Note (IAN) 135/10[224]; DMRB, Volume 11, Section 2, Part 2 – Environmental Impact Assessment[225] and draws upon the Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA 3)[226].

9.5.2 The assessment of significance for both landscape and visual effects of the Scheme has been based upon a combination of magnitude and sensitivity,

[223] Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 5 Landscape Effects (Highways Agency, 1993).
[224] Interim Advice Note 135/10 (W) Welsh Government, 2014c.
[225] DMRB, Volume 11, Section 2, Part 2 – Environmental Impact Assessment (Highways Agency, 2008).
[226] Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA 3), 2013.

following the assessment matrix as laid out within the Interim Advice Note (IAN) 135/10 Landscape and Visual Effects Assessment, see Table 9.9. The definitions of significance of effects contained within the IAN 135/10[227] are specific to highways and therefore appropriate for the Scheme.

9.5.3 The assessment of landscape and visual effects was preceded by a review of baseline information to inform the landscape and visual context. This also included analysis of the planning framework and statutory designations. The assessment was undertaken by a Landscape Architect, who visited the study area in October 2018, when vegetation was still in leaf. This process identified, informed and refined the number and type of visual receptors looking towards the Scheme, the nature of the views and the sensitivity of the receptors. Visual receptors and viewpoints defined during the Option Selection Stage were checked and refined as part of the assessment. The location of these viewpoints is shown on Figure 9.7 and 9.14 in Volume 3.

9.5.4 Photo sheets have been prepared for the receptors identified as being affected by the Scheme and are shown in Figures 9.15-9.46 in Volume 3. Photographs have been taken in accordance with the following guidance: Photography and Photomontage in Landscape and Visual Impact Assessment, Landscape Institute Advice Note 01/11[228] and with reference to the Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA 3)[205]. Photomontages have been prepared for a series of key receptors within the Kent Downs AONB and are shown in Figures 9.51-9.59 in Volume 3. Each includes a corresponding view to illustrate the Scheme at year 1, year 5 and year 15 post completion.

9.5.5 The following resources were utilised to establish the baseline landscape and visual amenity conditions:

- The Landscape Assessment of Kent (Kent County Council, 2004)[229];
- Kent Downs AONB Management Plan 2014-2019 (Kent Downs Area of Outstanding Natural Beauty, 2014)[230];
- Kent Downs AONB Landscape Design Handbook (Kent Downs Area of Outstanding Natural Beauty, 2004)[231];
- Kent Downs AONB Rural Streets and Lanes: a design handbook (Kent Downs Area of Outstanding Natural Beauty, 2009)[232];
- Natural England - National Character Area Profiles: 113 North Kent Plain (2012) and 119 North Downs (2013)[233];
- 1:25,000 Ordnance Survey Explorer Map Sheet 149: Sittingbourne to Faversham[234];

[227] IAN 135/10 (Highways Agency, 2010)
[228] Photography and Photomontage in Landscape and Visual Impact Assessment, Landscape Institute Advice Note 01/11 (Landscape Institute, 2011). Available online (http://publications.naturalengland.org.uk/publication/35012?cache=1543317178.2).
[229] The Landscape Assessment of Kent (Kent County Council, 2004).
[230] Kent Downs AONB Management Plan 2014-2019 (Kent Downs Area of Outstanding Natural Beauty, 2014).
[231] Kent Downs AONB Landscape Design Handbook (Kent Downs Area of Outstanding Natural Beauty, 2004).
[232] Kent Downs AONB Rural Streets and Lanes: a design handbook (Kent Downs Area of Outstanding Natural Beauty, 2009).
[233] Natural England - National Character Area Profiles: 113 North Kent Plain (2012) and 119 North Downs (2013), available online (http://publications.naturalengland.org.uk/publication/35012?cache=1543317178.2).
[234] 1:25,000 Ordnance Survey Explorer Map Sheet 149: Sittingbourne to Faversham.

- Map data: Google, DigitalGlobe (Google Earth Pro)[235]; and
- Phase 1 Habitat Survey (Chapter 7 Biodiversity).

Assessment criteria and assignment of significance

Receptor sensitivity – landscape

Overview

9.5.6 The sensitivity of a landscape is an important consideration informing the assessment of the significance of an effect and is based upon the capacity of a landscape to accommodate change of the type proposed, without causing harm to the character of the landscape. For example, a less sensitive, more 'robust' landscape would be able to accommodate changes of the type proposed whilst essentially retaining the same set of key characteristics. Conversely, a landscape with a very high sensitivity to changes of the type proposed could have these key characteristics changed to such an extent that the landscape ceases to be what it once was. The emphasis of these judgements must be focused on change 'of the type proposed' as a landscape may be able to accommodate certain types of development without changing its essential character or affecting its key components, whereas other types of development could not be accommodated in this way.

9.5.7 As required in paragraph 3.9 of IAN 135/10[217]: 'The outputs from the landscape character assessment (i.e. landscape characteristics, their condition and value) should be considered to assess their sensitivity to changes arising from the project; 'The determination of the sensitivity of the landscape resource is based upon an evaluation of each key element or characteristic of the landscape likely to be affected. The evaluation will reflect such factors as its quality, value, contribution to landscape character, and the degree to which the particular element or characteristic can be replaced or substituted.' (GLVIA para. 7.1.7)'.

9.5.8 Susceptibility to change means the 'ability of the landscape receptor to accommodate the proposed development without undue consequences for the maintenance of the baseline situation and/or the achievement of landscape policies and strategies' (GLVIA, First Edition, para 5.40[236]). The 'value' of the landscape receptor is therefore identified using the above criteria and susceptibility to change.

Determining quality/condition and value of the baseline landscape

9.5.9 Table 9.2 below sets out the criteria used to assess the quality/condition of the elements that make up the baseline landscape character areas within the study area for the Scheme. 'The condition (i.e. quality) of the elements which make up the landscape should also be assessed' as required in paragraph 3.18 of the IAN 135/10.

9.5.10 Landscape quality/condition is 'based on judgements about the physical state of the landscape, and about its intactness, from visual, functional, and ecological perspectives. It also reflects the state of repair of individual features and

[235] Map data: Google, DigitalGlobe (Google Earth Pro).
[236] Guidelines for Landscape and Visual Impact Assessment, First Edition (GLVIA), 2002.

elements which make up the character in any one place' as per the definition in the glossary of the IAN 135/10.

Table 9.2: Landscape quality/condition criteria and descriptors

Quality/condition	Description
Exceptional	• Includes areas that exhibit a strong, positive character with value and distinct features in a balanced combination of built development, landform and land cover, contributing to unity, richness and harmony, and creating a strong sense of place. • These are landscapes that are considered to be of particular importance to conserve on a national or international level. Includes nationally recognised areas such as Areas of Outstanding Natural Beauty (AONBs).
Good	• Includes areas that exhibit a positive character and sense of place, but which may have evidence of the degradation or erosion of some features, resulting in areas of a more mixed character and occasional detracting features. • There is a reasonable distribution of trees and shrub cover and the overall view of the area is pleasant. It is potentially sensitive to change. • In general, change may be detrimental if inappropriately dealt with, but may require special or particular attention to detail. Landscape designations of cultural and historical value may be present.
Ordinary	• Includes areas with a distinguishable landscape structure often dominated by land use, such as primarily functional development and some detracting features. • Few distinctive features worthy of conservation on a local scale with scope for positive enhancement. Land may have a local landscape designation.

Table Source: Various

9.5.11 Using the criteria outlined in Table 9.3 below, the assessment of landscape quality/condition is then used to inform the landscape value of the local landscape character areas within the study area for the Scheme, as described in paragraph 2.8 of the IAN 135/10: 'the end result in terms of providing the landscape baseline for the project is to divide the study area into specific landscape character areas, with an assessment as to their quality/condition, together with a judgement as to the value of the landscape both as a whole and of the individual character areas, features and elements that make up the landscape and define its sense of place'.

9.5.12 Landscape value is defined as: 'the relative value or importance attached to a landscape (often as a basis for designation or recognition), which expresses national or local consensus, because of its quality, special qualities including perceptual aspects such as scenic beauty, tranquillity or wildness, cultural associations or other conservation issues', as defined in the IAN 135/10.

Table 9.3: Criteria and definitions of landscape value

Value	Descriptors
High	• High importance and rarity, national and international scale, limited potential for substitution.
Medium	• High or medium importance and rarity, regional scale, limited potential for substitution.
Low	• Low or medium importance and rarity, local scale.

Table Source: Based on HA 205/08 (Highways Agency et al., 2008).

Determining landscape susceptibility

9.5.13 The word 'susceptibility' relates to the state of being likely or liable to be influenced or harmed by a particular thing.

9.5.14 Susceptibility to change is defined in paragraphs 5.40-5.41 of the Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA 3), 2013 as follows:

- Paragraph 5.40: 'This means the ability of the landscape receptor (whether it be the overall character or quality/condition of a particular landscape type or area, or an individual element and/or feature, or a particular aesthetic and perceptual aspect) to accommodate the proposed development without undue consequences for the maintenance of the baseline situation and/or the achievement of landscape planning policies and strategies'; and
- Paragraph 5.41: 'The assessment may take place in situations where there are existing landscape sensitivity and capacity studies, which have become increasingly common. They may deal with the general type of development that is proposed, in which case they may provide useful preliminary background information for the assessment. But they cannot provide a substitute for the individual assessment of the susceptibility of the receptors in relation to change arising from the specific development proposal'.

9.5.15 To understand susceptibility to change, the various characteristics/factors that make up a particular landscape must be identified, and consideration given as to how these will be affected by the proposed development. Landscape susceptibility is appraised through consideration of the baseline characteristics of the landscape and, in particular, the scale or complexity of a given landscape.

9.5.16 The evaluation of landscape susceptibility is undertaken with reference to a three-point scale, as outlined in Table 9.4 below:

Table 9.4: Criteria and definitions of landscape susceptibility

Landscape susceptibility	Descriptors
High	Landscapes which, by nature of their character, would be most susceptible to changes of the type proposed and are considered to be intolerant of even minor change. Typically, these would be: • Intimate, smaller-scale landscapes (relative to the development proposed); • Complex, organic/variable landscapes; • Landscapes of an irregular pattern;

Landscape susceptibility	Descriptors
	• Landscapes where features/elements are harmonious (and hence more easily disrupted) and give rise to positive character; • Landscapes traditional in style, or where natural influences predominate; • Landscapes which have a clear relationship to other surrounding landscapes, typically with views in and out; and • Landscapes with few or no screening features.
Medium	Landscapes which, by nature of their character, would be partly susceptible to changes of the type proposed and are considered to be tolerant of some degree of change. Typically, these would be: • Medium-scale landscapes (relative to the development proposed); • More open, or less complex landscapes; • There will be a range of landscape features/elements with some of those elements creating a degree of harmony and others creating a degree of discord within the landscape; • Landscapes of a mixed style and with some natural influences; • Landscapes which partly relate to other surrounding landscapes, typically with some views in and out; and • Landscapes featuring partial screening features.
Low	Landscapes which, by nature of their character, would be less susceptible to changes of the type proposed and are considered to be tolerant of a large degree of change. Typically, these would be: • Larger-scale landscapes (relative to the development proposed); • Simple landscapes with a consistent pattern of features/elements; • Landscapes where geometric and/or linear forms are commonplace; • A landscape where the features/elements present (whether built/designed or naturalistic) do not accord with one another, are arranged haphazardly and/or detract from the overall character; • A landscape that includes contemporary/industrial development, or that is clearly functional in land use; • Landscapes where there is no clear relationship with other surrounding landscapes e.g. typically with no views in and out; and • Landscapes where views are frequently interrupted by screening features e.g. vegetation cover or variations in landform.

Table Source: Various

Determining landscape sensitivity

9.5.17 Using the criteria outlined in Table 9.4 above, the assessment of landscape susceptibility is then used in conjunction with landscape value, to inform the landscape sensitivity of the local landscape character areas within the study area for the Scheme.

9.5.18 Landscape sensitivity is defined as 'The extent to which a landscape can accept change of a particular type and scale without unacceptable adverse effects on its character' as defined by the IAN 135/10. Landscape sensitivity relates to the stability of a landscape's character, the degree to which that character is robust enough to continue and to be able to recuperate from loss or damage. A landscape with a character of high sensitivity is one that, once lost, would be

difficult to restore; a character that, if valued, must be afforded particular care and consideration in order for it to survive.

9.5.19 Susceptibility to change and landscape value are taken into consideration when determining the sensitivity of landscape receptors. In addition, the table derived from the methodology and examples contained in Annex 1, Table 2 of the IAN 135/10, has also been consulted as a basis for determining landscape sensitivity. See Table 9.5 below:

Table 9.5: Landscape sensitivity

Sensitivity	Description
High	Landscapes which, by nature of their character, would be unable to accommodate change of the type proposed. Typically, these would be: • Of high quality with distinctive elements and features making a positive contribution to character and sense of place; • Likely to be designated, but the aspects that underpin such value may also be present outside of the designated areas, especially at the local scale; • Areas of special recognised value through use, perception or historic and cultural associations; and • Likely to contain features and elements that are rare and could not be replaced.
Moderate	Landscapes which, by nature of their character, would be able to partly accommodate change of the type proposed. Typically, these would be: • Comprised of common place elements and features creating generally unremarkable character but with some sense of place; • Locally designated, or their value may be expressed through non-statutory local publications; • Containing some features of value through use, perception or historic and cultural associations; and • Likely to contain some features and elements that could not be replaced.
Low	Landscapes which, by nature of their character, would be able to accommodate change of the type proposed. Typically, these would be: • Comprised of some features and elements that are discordant, derelict or in decline, resulting in indistinct character with little sense of place; • Not designated; • Contain few, if any, features of value through use, perception or historic and cultural associations; and • Contain few, if any, features and elements that could not be replaced.

Table Source: Annex 1, Table 2 of the Interim Advice Note (IAN) 135/10 (Highways Agency, 2010).

9.5.20 The overall landscape sensitivity judgement is a complex and non-linear process, taking into consideration intrinsic and inherent sensitivity, susceptibility to change of the type proposed, and landscape value. For example, a highly valued, intrinsically sensitive landscape (such as a National Park) may have a low susceptibility to change, due both to the characteristics of the landscape and the nature of the change proposed. In this LVIA, landscape sensitivity is expressed on a three-point scale of High, Moderate or Low. Table 9.5 above is provided as a simple example of landscape sensitivity values; however, the final assessment of sensitivity is one of professional judgement based upon

consideration of the susceptibility and value assessments, with a statement to support the judgement made.

Receptor sensitivity – visual

Overview

9.5.21 As per paragraph 2.15 of the Interim Advice Note (IAN) 135/10, visual sensitivity 'depends on the location, context and expectations of the viewer (e.g. the occupier of a residential property with open views would be highly sensitive, whereas an office worker within an urban context would be less so)' and as required in IAN 135/10, visual sensitivity is to be assessed in terms of the 'susceptibility of the receptor to the type of change arising from the specific proposal in terms of views and visual amenity; and also the value attached to the particular views by the receptor' (paragraph 3.26 of the Landscape Institute and the Institute of Environmental Management and Assessment, 2013).

Determining visual susceptibility

9.5.22 The susceptibility of visual receptors to change is defined in paragraph 6.32 of the Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA 3), 2013:

9.5.23 'The susceptibility of different visual receptors to changes in views and visual amenity is mainly a function of:

- The occupation or activity of people experiencing the view at particular locations; and
- The extent to which their attention or interest may therefore be focused on the views and the visual amenity they experience at particular locations'.

9.5.24 A range of visual amenity receptors were identified during the desk study and verified during the field survey work. The extent and nature of their views have been described and the susceptibility of the receptors has been defined. In addition to the consideration of the quality of view (i.e. the better the view, the more susceptible the receptor), the susceptibility of visual receptors is also dependent on the occupation or activity of people experiencing the view at particular locations and the extent to which their attention or interest may therefore be focused on the view. For example, occupiers of residential properties are likely to have a high susceptibility, due to the importance of a home's surroundings in affecting the enjoyment of that home and the long-term nature of the experience of those surroundings. By contrast, people in their place of work are likely to have a low susceptibility to change, as their attention would generally be focused on their work or activity and the setting does not have a direct bearing on the quality of their working life. In addition, the existing baseline visual amenity has a bearing on a receptor's likely susceptibility to the identified impacts. If, for example, the identified receptors are recreational walkers using an area that is already dominated by residential development, then their susceptibility to this type of development would be less than if the baseline was of open countryside.

9.5.25 The evaluation of visual susceptibility is further explained in Table 9.6 below and is undertaken with reference to a three-point scale:

Table 9.6: Criteria and definitions of visual susceptibility

Visual susceptibility	Descriptors
High	The visual receptors most susceptible to change are likely to include: • Residents at home; • People engaged in outdoor recreation, whose attention/interest is likely to be focused on the landscape or particular views, including from Public Rights of Way (PRoWs); • Visitors to heritage assets or other attractions, where views of the surroundings are an important contributor to the experience; • Communities where views contribute to the landscape setting enjoyed by residents; and • Travellers on scenic routes.
Medium	Visual receptors considered to be tolerant of some degree of change include the following: • People engaged in outdoor sport or recreation which does not involve or depend upon appreciation of views of the landscape; and • People at their place of work whose attention may be focused on their work or activity, not on surroundings, and where the setting is not important to the quality of working life (although there may be occasions where views are an important contributor to the setting and quality of working life).
Low	Visual receptors likely to be less sensitive to change include the following: • Travellers on road, rail, or other transport routes. These receptors are generally focused on the road corridor, whilst views into adjacent landscapes are usually transient and glimpsed.

Table Source: Various

9.5.26 In conjunction with the criteria outlined in Table 9.6 above, the visual amenity experienced by those receptors is also to be taken into account when identifying and categorising the relative susceptibility of a visual receptor. Paragraph 6.5 of the Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA 3), 2013, states the following: 'The division is not black and white and in reality there will be a gradation in susceptibility to change. Each project needs to consider the nature of the groups of people who will be affected and the extent to which their attention is likely to be focused on views and visual amenity'.

9.5.27 For instance, the presence of existing detracting features in any given view may reduce the visual amenity of those experiencing the view. This may therefore reduce their susceptibility to certain types of change and ultimately their sensitivity.

Value attached to views

9.5.28 In accordance with paragraph 6.37 of the Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA 3) 2013, when considering the relative value attached to a view, the following points should be taken account of:

- Recognition of the value attached to particular views, for example in relation to heritage assets, or through planning designations; and
- Indicators of the value attached to views by visitors, for example through appearances in guidebooks or on tourist maps, provision of facilities for their enjoyment and references to them in literature or art.

9.5.29 The assessment of value is expressed using a three-point verbal scale of High, Medium or Low, with justification as to why the judgement has been made.

Determining sensitivity of visual receptors

9.5.30 The susceptibility to change of visual receptors and the value attached to views is considered together to form a judgement on the sensitivity of visual receptors. Due to the non-linear and complex relationship between susceptibility and value, professional judgement is the primary determinant of the attributed sensitivity value.

9.5.31 Visual sensitivity is expressed on a three-point scale of High, Moderate or Low, with justification for the particular sensitivity attributed to each visual receptor, so that it is clear how each judgement has been formulated.

Magnitude of Impact

9.5.32 For the purpose of both landscape and visual impact assessment, impacts of the Scheme have been graded according to their scale or magnitude. The magnitude of impact has been determined through consideration of the following aspects:

- The size or scale of the impact: The extent of landscape elements/view that would be lost or affected and the proportion that this represents within the study area, alongside a consideration of the contribution that each element makes to the character of the study area. The degree to which aesthetic or perceptual aspects of the landscape or views would be altered by the removal of existing elements or the addition of new ones, and whether the impact changes the key characteristics of the landscape or view;
- Geographical extent: The geographical area over which the impact will be felt; and
- Duration and reversibility of impacts: Whether the impact is short- or long-term in nature, and whether the impacts can be completely reversed or are permanent. When discussing short-term effects within the report, for the nature of this LVIA, short-term relates to the construction period for the Scheme which is set to be for a likely duration of 18 months.

9.5.33 In accordance with the DMRB IAN 135/10, impacts have been rated according to a five-point scale: major, moderate, minor, negligible and no change, using the criteria laid out in Tables 9.7 and 9.8 below.

9.5.34 The terms used to describe the magnitude of landscape impacts are set out in Table 9.7 below and are based on the IAN 135/10.

Table 9.7: Magnitude and nature of landscape impact and typical descriptors

Magnitude of impact	Typical criteria descriptors
Major Adverse	Total loss or large-scale damage to existing character or distinctive features and elements, and/or the addition of new but uncharacteristic conspicuous features and elements.
Moderate Adverse	Partial loss or noticeable damage to existing character or distinctive features and elements, and/or the addition of new but uncharacteristic noticeable features and elements.
Minor Adverse	Slight loss or damage to existing character or features and elements, and/or the addition of new but uncharacteristic features and elements.
Negligible Adverse	Barely noticeable loss or damage to existing character or features and elements, and/or the addition of new but uncharacteristic features and elements.
No Change	No noticeable loss, damage or alteration to character or features or elements.
Negligible Beneficial	Barely noticeable improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic elements.
Minor Beneficial	Slight improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic elements.
Moderate Beneficial	Partial or noticeable improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic and noticeable features and elements, or by the addition of new characteristic features.
Major Beneficial	Large-scale improvement of character by the restoration of features and elements, and/or the removal of uncharacteristic and conspicuous features and elements, or by the addition of new distinctive features.

Table Source: IAN 135/10, Annex 1, Table 1

9.5.35 The terms used to describe the magnitude of visual impacts set out in Table 9.8 below, are based on Annex 2, Table 2 of the IAN 135/10. The inference from the guidance is that the five-point scale of criteria applies to both negative (adverse) or positive (beneficial) due to the nature of change according to their scale or magnitude. In applying this, we have assessed negative impacts on the basis that the project, or a part of it, would become a detracting feature or focal point of the view, and assessed positive impacts, where the project or part of it would result in an improvement in the view, resulting from the restoration and/or screening or removal of existing features and elements, or by the addition of new characteristic elements forming a focal point and/or feature of visual interest.

Table 9.8: Magnitude of visual impact and typical descriptors

Significance	Typical criteria descriptors
Major	The project, or part of it, would become the dominant feature or focal point of the view.
Moderate	The project, or part of it, would form a noticeable feature or element of the view, which is readily apparent to the receptor.
Minor	The project, or a part of it, would be perceptible but not alter the overall balance of features and elements that comprise the existing view.
Negligible	Only a very small part of the project would be discernible, or it is at such a distance that it would form a barely noticeable feature or element of the view.
No change	No part of the project, or work or activity associated with it is discernible.

Table Source: IAN 135/10, Annex 2, Table 2

Significance of effect

9.5.36 The magnitude of impact has been combined with the sensitivity of the landscape/visual receptors to establish a resultant category of significance of effect, expressed as a scale ranging from neutral to very large, which can be positive (beneficial) or negative (adverse). This process has been carried out in accordance with Annex 1, Table 3 and Annex 2, Table 3 of the IAN 135/10, and as set out in Table 9.9 below:

Table 9.9: Landscape and visual – significance of effect categories

Landscape/visual sensitivity	Magnitude of impact				
	No Change	Negligible	Minor	Moderate	Major
High	Neutral	Slight	Slight / Moderate	Moderate / Large	Large / Very Large
Moderate	Neutral	Neutral / Slight	Slight	Moderate	Moderate / Large
Low	Neutral	Neutral / Slight	Neutral / Slight	Slight	Slight / Moderate

Table Source: Table 3 of Annex 1 / 2 of the Interim Advice Note (IAN) 135/10

9.5.37 The terms used to describe the significance of effect categories are set out in Tables 9.10 and 9.11 below and are based on Table 4 of Annexes 1 and 2 of the IAN 135/10.

Table 9.10: Landscape – typical descriptors of significance of effect categories

Significance	Description
Very large Beneficial (Positive) Effect	The project would: • Greatly enhance the character (including quality and value) of the landscape; • Create an iconic high-quality feature and/or series of elements; and • Enable a sense of place to be created or greatly enhanced.
Large Beneficial (Positive) Effect	The project would: • Enhance the character (including quality and value) of the landscape; • Enable the restoration of characteristic features and elements lost as a result of changes from inappropriate management or development; and • Enable a sense of place to be enhanced.
Moderate Beneficial (Positive) Effect	The project would: • Improve the character (including quality and value) of the landscape; • Enable the restoration of characteristic features and elements partially lost or diminished as a result of changes from inappropriate management or development; and • Enable a sense of place to be restored.
Slight Beneficial (Positive) Effect	The project would: • Complement the character (including quality and value) of the landscape; • Maintain or enhance characteristic features and elements; and • Enable some sense of place to be restored.
Neutral Effect	The project would: • Maintain the character (including quality and value) of the landscape; • Blend in with characteristic features and elements; and • Enable a sense of place to be retained.
Slight Adverse (Negative) Effect	The project would: • Not quite fit the character (including quality and value) of the landscape; • Be at variance with characteristic features and elements; and • Detract from a sense of place.
Moderate Adverse (Negative) Effect	The project would: • Conflict with the character (including quality and value) of the landscape; • Have an adverse impact on characteristic features or elements; and • Diminish a sense of place.
Large Adverse (Negative) Effect	The project would: • Be at considerable variance with the character (including quality and value) of the landscape; • Degrade or diminish the integrity of a range of characteristic features and elements; and • Damage a sense of place.
Very Large Adverse (Negative) Effect	The project would: • Be at complete variance with the character (including quality and value) of the landscape; • Cause the integrity of characteristic features and elements to be lost; and • Cause a sense of place to be lost.

Table Source: Annex 1, Table 4 of the Interim Advice Note (IAN) 135/10

Table 9.11: Visual – typical descriptors of significance of effect categories

Significance	Description
Very large Beneficial (Positive) Effect	The project would create an iconic new feature that would greatly enhance the view.
Large Beneficial	The project would lead to a major improvement in a view from a highly sensitive receptor.
Moderate Beneficial	The proposals would cause obvious improvement to a view from a moderately sensitive receptor, or perceptible improvement to a view from a more sensitive receptor.
Slight Beneficial	The project would cause limited improvement to a view from a receptor of medium sensitivity or would cause greater improvement to a view from a receptor of low sensitivity.
Neutral	No perceptible change in view.
Slight Adverse	The project would cause limited deterioration to a view from a receptor of medium sensitivity or cause greater deterioration to a view from a receptor of low sensitivity.
Moderate Adverse	The project would cause obvious deterioration to a view from a moderately sensitive receptor, or perceptible damage to a view from a more sensitive receptor.
Large Adverse	The project would cause major deterioration to a view from a highly sensitive receptor and would constitute a major discordant element in the view.
Very Large Adverse	The project would cause the loss of views from a highly sensitive receptor and would constitute a dominant discordant feature in the view.

Table Source: Annex 2, Table 4 of the Interim Advice Note (IAN) 135/10

9.6 Assumptions and limitations

9.6.1 Assumptions and limitations relating to ZVIs produced specifically for the LVIA include the following:

- The verified ZVIs are based on 5 m Digital Terrain Map (DTM) data, used to identify areas from which the Scheme would theoretically be visible;
- The DTM data reflects the ‘bare earth’ conditions with heights data on a 5 m grid and does not allow for minor undulations in topography;
- In order to achieve a more accurate representation of the visibility of the Scheme, existing substantial built form and woodland, taken from the Ordnance Survey Vector Map were added to the terrain and have been extruded to the following conservative estimates of average heights above ground level:
  - Built form: 8 m high, representing an average 2-storey residential building;
  - Substantial areas of structural vegetation: 5 m high representing a semi-mature deciduous woodland; and
  - Mitigation planting and retained woodland were added and extruded to a height of 5 m for the year 15 summer scenario only (refer to Figure 9.13 in Volume 3).

- The ZVI was generated by computer software which places 4.5 m high columns on the highest proposed points at either end and every 100 m along the Scheme. This means that an additional 4.5 m was added to the road levels to account for high-sided vehicles. A value of 1.5 m was used to simulate eye height; and
- Small individual buildings, hedgerows and individual trees have not been included in this model, but in reality, where present, would provide additional screening. Therefore, the ZVI shows a worst-case scenario in terms of the predicted extent of 'visibility'.

9.6.2 Assumptions relating to construction specific to the LVIA include the following:

- The site offices (due to spatial constraints under the Stockbury viaduct) are to be double stacked to a height of 5.4 m; and
- Cranes would be used for the construction of the flyover.

9.6.3 Assumptions in assessing the impacts of the Scheme in the first year of Operation (year 1) relevant to the LVIA include the following:

- Proposed tree and shrub planting would range in height from 0.6-0.9 m for whips;
- Hedgerow planting would be between 0.6 and 0.9 m high; and
- Areas of species-rich grassland would yet to be fully established.

9.6.4 Assumptions in assessing the impacts of the Scheme in the fifteenth year of Operation (year 15) relevant to the LVIA include the following:

- Proposed tree and shrub planting would range in height from 5 to 6 m;
- Proposed hedgerows would range in height from 2 to 3 m; and
- Species-rich grassland would have established.

9.6.5 One of the limitations of the LVIA, is that a night-time assessment has not been undertaken, however, a summary of the impacts of lighting during the daytime and night-time will be provided as part of the assessment, this assessment will be based upon professional judgement and consider details relating to the existing and proposed lighting scenarios.

9.6.6 Due to programme constraints, the LVIA field survey and associated photographs were undertaken during the summertime, when vegetation was still fully in leaf. Therefore, photographs do not represent the views experienced during the winter time. However, winter views have been accounted for as part of the assessment (as part of the construction phase assessment and the operational phase year 1 assessment) and professional judgement and experience have been used to determine the impacts of the Scheme during winter months and from the viewpoint locations, taking into account the loss of leaves from deciduous trees during the winter time and the resulting impact and opening up of views of the Scheme.

9.6.7 The Scheme has been assessed in relation to existing structures, namely, the Stockbury viaduct, which is 15.3 m above ground level to an approximate height of 17.29 m.

9.7 Baseline conditions

Landscape designations

9.7.1 The locations of environmental designations are shown on the Environmental Constraints Figure 2.1 in Volume 3.

Area of Outstanding Natural Beauty (AONB)

9.7.2 Within the study area, the primary protected national designation, is that of the Kent Downs Area of Outstanding Natural Beauty (AONB), a nationally important protected landscape. Within the study area, the M2 corridor forms the northern boundary for the AONB (see Figure 9.1 in Volume 3).

9.7.3 The Kent Downs AONB is renowned for its special characteristics, including: its dramatic landform and topography, panoramic and long-ranging views, rich habitats, mixed farmland, extensive Ancient Woodland, tranquillity, remoteness and its historic and built heritage.

9.7.4 The Kent Downs AONB Landscape Assessment prepared by the Countryside Commission (1995 CCP 479) identified 13 main character areas in the AONB, in recognition of the local identity of the different areas of the AONB landscape.

9.7.5 The Kent Downs Landscape Character Area 8: Mid Kent Downs, falls within the study area. Key characteristics for the Mid Kent Downs Character Area can be found in Table F.6 of Appendix F in Volume 2. For reference, the following viewpoints are located within the Kent Downs AONB: VP 3, VP 6, VP 8, VP 9, VP 10, VP 11, VP 13, VP 14, VP 15 and VP 16. Please refer to Figure 9.1 in Volume 3 for the extent of the Kent Downs AONB and Figure 9.7 in Volume 3 for the Viewpoint Locations.

9.7.6 Drawing from the character areas defined by the Countryside Commission in 1995, the Landscape Assessment of Kent (LAK)[237] further described the Mid Kent Downs Landscape Character Area in terms of its condition and sensitivity. In addition, Swale Borough Council (SBC) and Maidstone Borough Council (MBC) have produced local level landscape character assessments (see Table F.5 of Appendix F in Volume 2).

9.7.7 The portion of the Kent Downs AONB within the 2 km study area was identified as the following regional character areas: Bicknor: Mid Kent Downs and Chatham Outskirts: Mid Kent Downs. Key landscape characteristics, potential conservation and enhancement opportunities for the Mid Kent Downs derived from the Landscape Assessment of Kent (2004), are listed in Table F.2 of Appendix F in Volume 2.

9.7.8 Landscape Character Assessment is recognised by the Kent Downs AONB as being a helpful tool for informing the management of the Kent Downs AONB landscape. It is noted that the Kent Landscape Group had identified that the County and Local Landscape Character Assessments do not necessarily align and that there is a need for a review of the Landscape Assessment of Kent (2004).

[237] The Landscape Assessment of Kent (Kent County Council, 2004).

9.7.9 The Kent Downs AONB has been considered as part of the assessment of effects on local Landscape Character Areas in Section 9.10 of this ES.

9.7.10 The potential for effects upon the visual amenity of people enjoying views from the Kent Downs AONB from various viewpoints has been considered as part of the visual assessment in Section 9.10.

Area of High Landscape Value (HLV)

9.7.11 Within the study area lies an Area of High Landscape Value (HLV), as identified by the Swale Adopted Local Plan (2017), see Figure 2.1 in Volume 3. These landscapes are locally designated and are seen as being scenically important in a county-wide context. Following field work, it was determined that there would be no impact to the Area of High Landscape Value or its setting, due to the Scheme not being visible from this location.

Ancient Woodland

9.7.12 There are two areas of Ancient Woodland within 30 m of the Scheme, which include Church Wood and Chestnut Wood (see Figure 2.1 in Volume 3).

9.7.13 Other areas of Ancient Woodland within the 2 km study area include: Frid Wood (1.2 km from the Scheme), Steps Hill Wood (1.5 km away from the Scheme), Squirrels Farm Wood (1.1 km away from the Scheme) and Gore Wood (0.8 km away from the Scheme).

9.7.14 The impact on Ancient Woodland is assessed in Chapter 7 Biodiversity, whilst this chapter considers the impact on visual amenity and landscape character relating to Ancient Woodland.

Heritage assets: Scheduled Monuments, Conservation Areas and Listed Buildings

9.7.15 Detailed information and potential impacts upon the identified heritage assets, is outlined in Chapter 11 Cultural Heritage. The extent to which Scheduled Monuments, Conservation Areas and Listed Buildings contribute to the cultural and historical aspects and overall character of the landscape is considered as part of the baseline assessment of sensitivity of the Landscape Character Area receptors. Landscape effects, including those resulting from changes to the settings of heritage assets, are considered under landscape character effects.

9.7.16 The potential for effects upon the visual amenity of people enjoying views from publicly accessible heritage assets has been considered as part of the visual assessment.

Ecological designations

9.7.17 The potential impacts upon designated ecological sites are covered in Chapter 7 Biodiversity; however, any potential impacts upon identified designations in relation to landscape character and visual amenity will be covered within this chapter. There are no National or Local Nature Reserves within the study area.

9.7.18 Statutory protected sites within the study area include: three important (protected) hedgerows at Oad Street, to the east of Amels Hill Track and to the east of Honeycrock Hill.

9.7.19 Non-statutory designated sites within the study area include: two Roadside Nature Reserves (RNRs) at Church Hill and Honeycrock Hill, Stockbury.

9.7.20 The following ecological designations can be found within the 2 km study area; however, following desk study review, it has been determined that there will be no landscape or visual impacts to these sites, due to their distance from the Scheme (see Figure 2.1 in Volume 3):

- Squirrel Wood, Stockbury Valley Local Wildlife Site (LWS), located west-southwest of the Scheme; and
- Stockbury Wood LWS located to the southwest of the Scheme.

Landscape and visual baseline

9.7.21 An overview of the landscape and visual baseline within the study area is outlined below and further details are provided in Appendix F in Volume 2.

National and Regional Character Areas

9.7.22 The extent and location of the National Character Areas (NCAs) and Regional Landscape Character Areas (LCAs) are shown on Figure 9.2 in Volume 3. A brief description of these areas is provided for context below and further details and judgements on sensitivity are provided in Appendix F in Volume 2.

9.7.23 National Character Areas (NCAs), as defined by Natural England, provide a broad description of landscape character. The NCAs of relevance and deemed likely to be impacted by the Scheme, are as follows: NCA 113 North Kent Plain located to the north of Stockbury roundabout and NCA 119 North Downs located to the south of the Scheme. These are shown on Figure 9.2 in Volume 3. Key landscape characteristics and potential conservation and enhancement opportunities are described in Table F.1 of Appendix F in Volume 2.

Regional Landscape Character Areas

9.7.24 The Regional Landscape Character Areas (LCAs) are identified by Kent County Council in The Landscape Assessment of Kent (2004). In comparison to the NCAs, the regional scale provides for a more detailed overview of the Landscape Character Areas relevant to the Scheme.

9.7.25 Regional Landscape Character Areas within the study area, are listed as follows:

- Bicknor: Mid Kent Downs – lies to the south of the M2 viaduct and occupies the western portion of the 2 km study area;
- Chatham Outskirts: Mid Kent Downs – lies to the south of the M2 viaduct and to the south of the 2 km study area; and
- Fruit Belt Character Area – lies to the north of the M2 viaduct and to the north of the study area.

9.7.26 These Regional Landscape Character Areas are shown on Figure 9.2 in Volume 3 and key landscape characteristics and potential conservation and enhancement opportunities are listed in Table F.2 of Appendix F in Volume 2.

9.7.27 Table 9.12 below provides a summary of the value, susceptibility, and sensitivity attributed to the Regional LCAs relevant to the Scheme.

Table 9.12: Summary of value, susceptibility, and sensitivity of the Regional Landscape Character Areas

Regional LCAs	Quality/ condition	Value	Susceptibility	Sensitivity
Bicknor: Mid Kent Downs	Good	High: • Lies within the nationally designated Kent Downs Area of Outstanding Natural Beauty (AONB); and • The presence of a nationally important Scheduled Monument: ringwork and baileys at Church Farm.	Medium	Moderate
Chatham Outskirts: Mid Kent Downs	Good	Medium: • Lies within the nationally designated Kent Downs Area of Outstanding Natural Beauty (AONB) and therefore its limited potential for substitution. Detracting features such as arable intensification, mixed 20th century style development, neglected orchards and the strong presence of the M2 and A249 within this LCA, lessen the overall value.	Medium	Moderate
Fruit Belt Character Area	Ordinary	Low: • Agricultural intensification and intensive fruit growing have resulted in a new form of landscape, a larger-scale open landscape. The LCA has been further blighted by Dutch elm disease, which has had a significant impact upon mature tree cover and hedgerows within the area. Further detraction and lessening of the overall value of the LCA is due to the presence of the M2, A249 and associated ribbon developments.	Low	Low

Local Landscape Character Areas (LCAs)

9.7.28 At a local scale, the Scheme lies within Swale Borough Council and Maidstone Borough Council. Both councils have produced Landscape Character Assessments, that have further refined the Regional Landscape Character Areas into Local Landscape Character Areas (LCAs). The Landscape Character Assessments are listed as follows:

- Swale Landscape Character and Biodiversity Appraisal SPD (Swale Borough Council, 2011)[238]; and

[238] Swale Landscape Character and Biodiversity Appraisal SPD (Swale Borough Council, 2011).

- Maidstone Landscape Character Assessment (Maidstone Borough Council, 2012)[239].

9.7.29 During the Option Selection Stage (Stage 2), Local LCAs were identified by both desk study and site visits. During the Preliminary Design Stage (Stage 3), further field survey was undertaken (following the guidance of IAN 135/10 and An Approach to Landscape Character Assessment, Natural England, 2014), to determine the impacts upon the identified Local LCAs. Those character areas where there would be no impact due to the Scheme, have been scoped out of further assessment, refer to Tables F.3 and F.4 in Appendix F in Volume 2.

9.7.30 Table F.5 in Appendix F in Volume 2 provides details of the key characteristics, quality or condition, and sensitivity of the character areas. The extents and locations of the Local LCAs are shown on Figure 9.3 in Volume 3.

9.7.31 Table 9.13 below provides a summary of the value, susceptibility, and sensitivity attributed to the Local LCAs relevant to the Scheme.

Table 9.13: Summary of value, susceptibility, and sensitivity of the Local Landscape Character Areas

Local LCAs	Quality/ condition	Value	Susceptibility	Sensitivity
Bredhurst and Stockbury Downs	Good	High: • Lies within the nationally designated Kent Downs Area of Outstanding Natural Beauty (AONB); and • The presence of a nationally important Scheduled Monument: ringwork and baileys at Church Farm.	Medium	Moderate
Hucking Dry Valleys	Good	High: • Lies within the nationally designated Kent Downs Area of Outstanding Natural Beauty (AONB) and therefore has limited potential for substitution. There are also local designations in the form of Roadside Nature Reserves (RNRs) within this LCA.	Medium	High
Borden Mixed Farmlands	Good	Medium: • Due to the presence of Listed Buildings within the character area and its proximity to the Kent Downs AONB; • Properties at Danaway, which run adjacent and parallel to the A249, are of a mixed 20th century style and feature an array of mixed boundaries creating a visually incoherent scene;	Medium	Moderate

[239] Maidstone Landscape Character Assessment (Maidstone Borough Council, 2012).

Local LCAs	Quality/ condition	Value	Susceptibility	Sensitivity
		• Fragmented hedgerows and field boundaries of post and wire fencing detract from the value of the landscape; and • Historic properties and the nature of the sunken, narrow and hedgerow-lined lanes enhance the rural and traditional character of the LCA. Mature treebelts running adjacent to the A249 provide valuable screening to the west of the character area.		
Newington Arable Farmlands	Ordinary	Medium: • Lies partially within the nationally designated Kent Downs AONB and informs part of the setting of the AONB, the reduced quality/condition of the landscape resulting from the A249, ribbon development and non-traditional 20th century housing styles has eroded the sense of place and distinctiveness of the character area. Due care and attention are to be given to the setting of the locally important Oad Street.	Low	Moderate
Deans Bottom	Good	High: • Lies within the designated Kent Downs AONB and exhibits a number of the positive landscape characteristics typical of the Kent Downs, including: the dry valley landscape, orchards, pasture, shelterbelts, wooded shaws, a prominence of hedgerows and hedgerow trees, scattered isolated farmsteads and narrow, enclosed lanes. The landscape habitats are of a good quality, and along with the presence of prominent traditional buildings and narrow rural lanes, these landscape features add to the scenic quality and peaceful nature of the valley.	Medium	High
Tunstall Farmlands	Good	Medium: • The presence of ancient and rare woodland, orchards, historic villages and hamlets, and narrow, winding lanes. However, the landscape features fragmented hedgerows and a lack of internal field boundaries as a result of agricultural intensification and enlargement of field sizes; and	Medium	Moderate

Local LCAs	Quality/ condition	Value	Susceptibility	Sensitivity
		• Remnant orchards feature as neglected elements within the landscape, the presence of 20th century buildings of a conflicting local vernacular and the incongruity of the scattered executive homes, have resulted in a decline of the landscape value, not least due to the presence of the A249 and M2 motorway within the character area.		

9.7.32 A summary of the Landscape Character Area sensitivity judgements attributed to the LCAs which are likely to be significantly affected by the Scheme are provided in Table 9.14 below.

Table 9.14: Summary of landscape sensitivity

Receptor	Sensitivity
Regional Landscape Character Areas	
LAK: Bicknor: Mid Kent Downs	Moderate
LAK: Chatham Outskirts: Mid Kent Downs	Moderate
LAK: Fruit Belt	Low
Local Landscape Character Areas	
MBC: Bredhurst and Stockbury Downs	Moderate
MBC: Hucking Dry Valleys	High
SBC: Borden Mixed Farmlands	Moderate
SBC: Newington Arable Farmlands	Moderate
SBC: Deans Bottom	High
SBC: Tunstall Farmlands	Moderate

Visual receptors

9.7.33 The Scheme is located within the base of a dry valley landscape, and therefore, the topography and nature of the landform and intervening vegetation limits visibility of the Scheme from the wider landscape. Views of the Scheme are generally restricted to within approximately 250 m of the Scheme, with occasional more distant views assessed within approximately 500 m of the site at elevated ground in Norton Green and within upper slopes of the dip valley within the Tunstall Farmlands LCA.

9.7.34 The existing junction is largely screened by mature roadside vegetation. However, the existing M2 viaduct, which crosses the valley, is a noticeable feature in the local landscape.

9.7.35 Following on from the Option Selection Stage (Stage 2) report, desk based study and field work were undertaken to identify the following visual receptors which may be affected by the Scheme (see Figure 9.5 in Volume 3). Judgements upon value, susceptibility to change and visual receptor sensitivity outlined in the following paragraphs, were made in accordance with the criteria and process outlined in Table 9.6 and paragraphs 9.5.21 – 9.5.31 (refer to Table F.9 of Appendix F in Volume 2 for the baseline assessment table, which provides further explanatory text to support the reasoning for the assigned visual sensitivity values attributed to the following visual receptors).

Residential receptors

- Residential receptors along the Maidstone road (southwestern edge of the settlement of Danaway) (VP 2);
- Milton Bungalow and Bowl Reed, in the vicinity of Oad Street overpass where it meets the M2 (VP 4);
- Whipstakes Farm, Oad Street (VP 6);
- Residential receptors adjacent to the A249 (between Honeycrock Hill and Whipstakes Farm, Oad Street) (VP 13);
- Hillside Farm, adjacent to the A249 (VP 15); and
- Residential receptors adjacent to the A249 (in the proximity of South Green Lane) (VP 16).

9.7.36 The nature of these views is rural but often impacted upon by the existing infrastructure, most notably the A249, the M2 and the existing M2 viaduct. These residential receptors are therefore considered to be moderately able to accommodate change and are therefore of a **Medium** *susceptibility* to change. The residential receptors are considered to be of **High** *sensitivity*. The locations for the residential receptors can be found on Figure 9.5 in Volume 3.

9.7.37 Following on from the Stage 2 Report, field work has determined that there are no views from the following properties due to intervening screening or topography and these receptors have been scoped out of further assessment:

- Residential receptors along Church Lane, Stockbury;
- Little Pett Farm;
- Cowstead;
- Chesley and Thrognall Farm;
- Munsgore Farm and Eyehorn Farm; and
- Residential receptors on the junction of Oad Street and Woodgate Lane.

Recreational receptors

9.7.38 The recreational receptors include: users of the Public Rights of Way (PRoWs) in the following locations (see Figure 9.1 in Volume 3):

- Public Right of Way (PRoW) KH81 (VP 3);
- Public Right of Way (PRoW) ZR70 (VP 7);

- Public Right of Way (PRoW) KH85 (VP 8 / VP 9 / VP 11);
- Public Right of Way (PRoW) ZR135 (VP 10);
- Pubic Right of Way (PRoW) ZR71 (VP 12); and
- Public Right of Way (PRoW) KH80 (VP 14 / VP 15).

9.7.39 These recreational receptors are predominantly located adjacent to the Scheme and therefore within close proximity of the infrastructure of the existing A249 and M2 motorway. All of the recreational receptors are located in rural or edge of village contexts. A number of the PRoWs lie within the Kent Downs AONB, these are as follows: PRoW KH81, PRoW ZR 135, PRoW KH80 and PRoW KH85.

9.7.40 Of the PRoWs within the Kent Downs AONB, PRoW KH85 is located immediately adjacent to the existing Stockbury roundabout and the infrastructure of the A249 and the M2 are a primary feature within the view. Therefore, KH85 and other viewpoints running immediately adjacent to or within the Scheme boundary, namely ZR70 and ZR71, are considered to be of **Medium** *visual susceptibility* and the value attached to these views is considered to be of a **Low** *value*, as these recreational users are travelling by foot along a transport route and therefore the visual amenity of the landscape or rural setting is blighted somewhat by the presence of the detracting features associated with the existing A249 and M2 respectively. These recreational receptors are able to accommodate a degree of change and their *sensitivity* is judged to be **Moderate**.

9.7.41 PRoWs within the Kent Downs AONB found at higher ground, such as: PRoW KH81, PRoW ZR135 and PRoW KH80, are of a **High** *susceptibility* to change as recreational users along these routes are likely to be focused upon the landscape or particular views within the AONB. Therefore, these recreational receptors are judged to be of a **High** *visual susceptibility* and with visual amenity of the views within the nationally designated Kent Downs AONB an important factor, these recreational receptors are deemed to be of a **High** *value* and a **High** *sensitivity* with limited ability to accommodate change.

9.7.42 Following on from the Stage 2 Report, field work has determined that there are no views from the following PRoWs due to intervening screening or topography and these have been scoped out of further assessment:

- Sittingbourne and Milton Regis Golf Course; and
- PRoW KH84; PRoW ZR72; PRoW ZR72A; PRoW ZR73; PRoW ZR128; PRoW ZR137; PRoW ZR73; PRoW ZR163; PRoW ZR162; PRoW ZR69; PRoW ZR160; ZR161; KH82; and KH653.

Transport receptors

9.7.43 Transport receptors include users of the local road network, in particular:

- Transport receptors travelling along Wormdale Hill (heading east towards the settlement of Danaway) (VP 1);
- Oad Street (in the vicinity of Whipstakes Farm, heading westward towards the existing A249) (VP 6);
- Users of the existing A249 travelling westwards towards the M2 J5 (VP 1 – for illustrative purposes only);

- Maidstone Road, Danaway (travelling westward towards the M2 J5) (VP 2); and
- Transport receptors using the Oad Street overpass as it crosses the M2 (looking westward towards the M2 J5) (VP 5).

9.7.44 The attention of these transport receptors will be focused upon navigating along the narrow and winding country lanes or the busy A249. With the exception of Oad Street, the *value* of these transport receptors is **Low** and their *visual susceptibility* is **Low**. The *sensitivity* of these visual receptors is judged to be **Low**.

9.7.45 The value of the local road, Oad Street (VP 6), is considered to be of **Medium** value to transport users. It is a locally designated rural lane protected by local policy (Swale Borough Council – Local Plan (2017)), sufficient weight and due regard is to be given to retaining its character and visual amenity. This road is also set within the nationally designated Kent Downs AONB. The Kent Downs AONB have produced a guidance document, Kent Downs AONB Rural Streets and Lanes: a design handbook (Kent Downs Area of Outstanding Natural Beauty, 2009), which demonstrates the value of rural streets and lanes within the AONB and their importance in contributing to the special characteristics of the AONB. Therefore, Oad Street's visual *susceptibility* is **Medium** and it is judged to have a **Moderate** visual *sensitivity*.

Employment receptors

9.7.46 Employment receptors include outdoor employment receptors, such as farms and small businesses found within the 2 km study area, in particular:

- Whipstakes Farm, Oad Street (VP 6);
- Equine facility, Oad Street (VP 4);
- Church Farm workers, Church Lane (VP3);
- Farm workers in the vicinity of Church Wood (VP 8, VP 9 and VP 11);
- Farm workers in the vicinity of PRoW ZR71 (VP 12);
- Stockbury Boarding Kennels and Police dog training facility (VP 16);
- Hillside Farm, adjacent to the A249 (VP 15); and
- Farm workers in the vicinity of North Green (VP14).

9.7.47 Outdoor employment receptors are more likely to take in the views of the countryside and therefore the *value* of their visual amenity is **Medium** as visual amenity contributes to the enjoyment of their work, with such views being less able to accommodate change, resulting in a judgement of **Medium** *visual susceptibility* due to the primary focus of such receptors being upon their work, rather than the view. Outdoor employment receptors have a **Moderate** *visual sensitivity*.

Heritage receptors

9.7.48 Heritage receptors include the Scheduled Monument adjacent to Church Farm (VP 3) and the Grade I listed, Church of St Mary Magdalene along Church Lane, Stockbury (VP 3). According to DMRB criteria, as set out in Chapter 11 Cultural

Heritage, the Scheduled Monument and the Grade I Listed Building are of a **High** national *value*.

9.7.49 Given the rural context of the setting to these heritage receptors and the presence of the existing A249, the visual amenity of people enjoying views from the setting of these heritage receptors is judged to be that of a **High** *visual susceptibility*. Combining these High values with the High visual susceptibilities, the sensitivity to change of these receptors is assessed as follows: the visual amenity of people enjoying views from setting of the Scheduled Monument and the Grade I Listed Building, is judged to be of a **High** *visual sensitivity* (due to a High value and High susceptibility).

Current baseline

9.7.50 The baseline for the Scheme is further defined below, following a series of structured headings based upon the landscape characteristics as detailed within the outline policy and published landscape character assessment information utilised within this assessment.

Landform and Geology

9.7.51 The study area features mixed geology, typical of the North Downs dip slope, with chalk found on higher ground, and head and clay-with-flints on the lower lying slopes. To the north of the Scheme, the landform is that of a rolling arable landscape, with a simple geology of Thanet bed deposits.

9.7.52 To the south and west of the Scheme, the landform is gently undulating, typical of a dry valley landscape, with a series of dip slope valleys (see Figure 9.4 in Volume 3). The landform of the dip slope limits views to areas within the valley and resultantly towards the existing A249, which is situated within the base of a dip slope valley.

9.7.53 The northern to eastern portion of the Scheme lies adjacent to Grade 2 and Grade 3 Agricultural Land. Where the Scheme adjoins or impacts upon agricultural land to the south and west of the Scheme boundary, the agricultural land is predominantly of a Grade 3 classification.

Vegetation pattern

9.7.54 The vegetation pattern of the study area is varied. To the southwest of the Scheme, about the vicinity of Honeycrock Hill, agricultural fields are of a small-medium irregular size, which allows for a sense of time depth, views towards the A249 are apparent from these fields, however, the rural lanes are densely vegetated by hedgerows and hedgerow trees, which limits views into the fields towards the A249. Elsewhere, agricultural fields within the study area are often larger in scale, particularly north of the M2 viaduct, this is in association with the intensification of agricultural land, which has led to the loss of historic, internal field boundaries, creating open views in these parts. There are areas of small-medium sized fields, isolated Ancient Woodlands (i.e Church Wood and Chestnut Wood – see Figure 2.1 in Volume 3), often adjacent to hedgerows, woodland shaws and grassland, which provide important ecological corridors. However, fragmentation of hedgerows can be found throughout the study area, particularly along the rural lanes and there is opportunity to reconnect these

habitat types through planting design measures and to improve the visual coherence of the landscape.

9.7.55 Mature vegetation associated with the major road corridors provides important visual screening and helps to lessen the impacts of the M2 and visually encloses the A249, which is within the base of the dry valley. To the south of the M2, views from agricultural fields are often more open towards the A249 due to fragmentation of tree belts; however, the landform is such that views are limited as the landform foreshortens views towards the base of the valley.

9.7.56 Remnant orchards appear as dilapidated features within the landscape, creating a sense of neglect. Further detraction is found in the equestrian facilities, whereby additional loss of internal field boundaries is encountered due to their replacement by a proliferation of post and wire fencing and other non-vegetative boundary treatments, particularly north of the M2 viaduct.

9.7.57 The vegetation pattern to the south-southwest of the Scheme is much more contained, with the dense woodland vegetation of the slopes of the dry valleys and lie of the land providing a much more intimate and enclosed character.

9.7.58 Overall, this is a study area that retains a strong rural character and feel, particularly to the south-southwest of the Scheme, but is eroded as it continues towards the M2 viaduct and beyond, where land uses have become more intensive and less traditional, and the management of the landscape less sympathetic.

Land use

9.7.59 Overall, there is no dominant land use within the study area, it is a mixture of cereal fields, orchards and collections of equestrian fields. South of the M2 viaduct, the land use is more traditional in character, with the presence of small-medium sized agricultural land bounded by woodland shaw and hedgerows. There are remnant orchards within the vicinity of Stockbury and close to Pett Farm to the south-southwest of the study area. Land use is less intensive to the south of the study area and is mainly for grazing, coppicing and paddocks.

9.7.60 To the north and adjacent to the M2 viaduct, fields have been enlarged due to agricultural intensification and to the northeast, plots have been subdivided for use as grazing land for horses. To the east-northeast of the Scheme, a large equine establishment with post and rail paddocks dominates the valley scape. Therefore, there is quite a distinct contrast to the feel of the landscape character between the north and the south of the M2 viaduct, with the north also further impacted by the presence of the Sittingbourne and Milton Regis Golf Course and its associated single-species shelterbelts that further erode the rural, traditional feel that is more apparent to the south.

Settlement

9.7.61 To the south of the M2 viaduct, there is a sense of mixed quality to the settlements. Immediately adjacent to the A249, there can be found modern, mixed style 20th century properties, some of these properties appear run down or function as businesses, such as a police dog training centre and boarding kennels. These properties are generally well screened from the A249, with the exception of the properties about the vicinity of Vale Cottages, sited south-

southwest of the Stockbury roundabout, which front without screening, directly onto the A249. These modern style properties do little to bolster the traditional, rural character of the study area and in combination, lead to an erosion of the sense of place and time depth of the area.

9.7.62 Moving up the dry valley scape, scattered farmsteads and properties along narrow-hedge lined lanes can be found. Isolated farms and the traditional dwellings of small villages helps to retain a strong rural feel and counteract the ribbon development immediately adjacent to the A249. The flint Church of St Mary Magdalene is a prominent visual feature within the study area and strengthens the historic and traditional qualities of the place.

9.7.63 Oad Street to the east of the study area is classified as an important rural lane. Properties along Oad Street are of a varying quality, with those closest in proximity to the A249 being of mixed 20th century styles or incongruous executive homes, demonstrating the urbanising influence of the transport corridors. Moving further eastwards there are examples of fine vernacular architecture and a number of these properties are Listed Buildings.

9.7.64 To the north of the M2 viaduct, the ribbon development along the Maidstone road in proximity to Chestnut Street is of a mixed 20th century style and further urbanises the character of the area. These areas lack distinctiveness and detract from the overall sense of place. On the whole, the study area is one of a variable quality – with fine examples of local vernacular architecture set against unsympathetic, mixed, 20th century ribbon developments.

Infrastructure

9.7.65 The A249 dual carriageway and the M2 motorway are prominent infrastructure features in the study area, with the A249 extending from southwest of the study area through to the northeast of the study area. The M2 motorway runs from the northwest of the study area down through to the southeast, both are in direct contrast with the historic and traditional pattern of rural roads within the area, which are often narrow, winding and with sharp bends.

9.7.66 The A249 is deeply set within the dry valley landscape and surrounded by woodland/tree belts along much of its path, which reduces the impact of the road upon the wider character area. However, there are vantage points at higher ground, such as at Norton Green, where the M2 viaduct is a noticeable feature in the middle ground. This industrial appearance is not out of character with the area, as there are also long views within the study area towards the Isle of Grain and the Medway Estuary, where large industrial features are present upon the horizon. Visual effects of the A249 are localised, but the noise from the A249 and M2 are fairly perceptible throughout the study area, which reduces the overall sense of tranquillity and rural quality.

Character of the night sky

9.7.67 The study area south of the M2 viaduct (within the Kent Downs AONB) is considered to be representative of ‘Environmental Zone E1 Natural’, which is a lighting environment that is intrinsically dark, in relation to its status as an Area of Outstanding Natural Beauty. North of the M2 viaduct, the study area is classified as ‘Environmental Zone E2 Rural’ which is of low district brightness and

examples of such lighting levels can be found in villages or relatively dark outer suburban locations.

9.7.68 Figure 9.8 in Volume 3 illustrates the Campaign to Protect Rural England's (CPRE's) Dark Sky mapping and shows that the darkest areas lie to the very edge of the southern portion of the study area, about the vicinity of Pett Farm and just south of Norton Green. The intervening vegetation and landform here are potentially contributing factors that limit the light pollution currently experienced adjacent to the transport corridors.

9.7.69 There are moderate levels of brightness/light about the vicinity of the existing Stockbury roundabout, this is in part due to the lighting present around the roundabout, and as a result of the age of the existing lighting and resulting, unnecessary light pollution/spill and obtrusive light.

9.7.70 The majority of the study area is green, at a light level of 1-2, which demonstrates that it is a fairly dark landscape, typical of a rural situation given the containment of the A249 and M2 within the bottom of the dry valley and the fact that the A249 is unlit beyond the Stockbury roundabout.

Tranquillity

9.7.71 Tranquillity relates to the degree of calm that people experience in places full of the sights and sounds of nature. Tranquillity is often found in parks and gardens, in rural settings and in National Parks – tranquil places are places to 'escape from it all' and to 'recharge our batteries'. Tranquillity is impacted by intrusive sights and sounds, particularly resulting from the sounds of manmade structures, such as new roads and poorly-designed lighting and power lines.

9.7.72 Figure 9.9 in Volume 3 illustrates the Campaign to Protect Rural England's (CPRE's) Tranquillity mapping. As can be seen in Figure 9.9 in Volume 3, the study area ranges from low levels of tranquillity (red) to moderate levels of tranquillity (yellow), the least tranquil areas are predominantly found along the transport corridors and to the north of the M2 viaduct where ribbon development and the urbanised edge of Sittingbourne becomes more apparent. Where portions of the study area are of a more moderate tranquillity grade, these are primarily agricultural areas adjacent to woodland blocks, such as about the vicinity of Church Wood to the north-northwest of the Scheme and Frid Wood to the southeast.

9.7.73 Despite the rural context and the AONB designation to parts of the study area, the existing tranquillity ranges from low to moderate and the impacts of the transport corridors and ribbon developments have evidently eroded the sense of tranquillity that would be usually associated with a rural or AONB setting.

Baseline assessment/assessment viewpoints

9.7.74 The baseline assessment was carried out during October 2018, when vegetation was still in leaf and therefore demonstrates the effect of planting and vegetation in softening/screening effects of the existing A249 Scheme and other urbanising features.

9.7.75 The visual baseline assessment describes and analyses 'visual receptors' that may have specific or general views of the study area and that the Scheme may

affect. The full visual baseline assessment can be found in Table F.9 of Appendix F in Volume 2. The visual baseline outlined provides an assessment of the sensitivity of the visual receptors based on the current situation.

9.7.76 A total of 16 viewpoints (VPs) have been selected to represent the landscape and visual receptors included in this assessment. For the location of the viewpoints, refer to Figures 9.7 and 9.14 in Volume 3.

9.8 Potential impacts

9.8.1 This section provides an overview of the potential impacts foreseen as a result of the Scheme, during construction and operation respectively. Committed mitigation measures that have been incorporated into the design and construction of the Scheme are set out in Section 9.9. The Scheme has the potential to affect landscape and visual receptors (beneficially or adversely), both during construction and during the Scheme's operation in the following ways.

Construction

9.8.2 Potential impact on the landscape and visual receptors during the construction phase would result from the following:

- General construction activity and presence of associated machinery during the 18-month construction period underneath the M2 viaduct;
- The location and use of the contractor compounds;
- Construction deliveries via the M2/M20 and A249;
- Temporary closure of existing PRoWs;
- All vehicle access will be via the A249 and the slip roads, no haul roads are planned for the Scheme;
- Excavation and remodelling of surface landform, including large-scale earth movements and general disturbance including the construction of cuttings and bunds;
- Temporary lighting to support night-time working with site task lighting provided by solar-powered LEDs;
- Hoarding and fencing associated with the construction works;
- Signage and features associated with traffic management measures;
- Temporary structures for the construction of the bridge;
- Topsoil is to be stored on-site in bunds within the site limits for re-use;
- Disruption to the existing network of woodland, hedgerow and other soft landscape features, including loss of vegetation and opening up of views towards the Scheme; and
- Equipment associated with larger structures such as the proposed Stockbury flyover.

Operation

9.8.3 Potential impacts on the landscape and visual receptors during the operational phase would result from the following:

- A249 flyover at a maximum height of 7.4 m above ground level and the proposed Stockbury roundabout, with approaches on embankments, and with two bridges over the proposed roundabout;
- Replacement and enlargement of the existing Stockbury roundabout with a new grade-separated junction;
- The proposed lighting design consists of 68 No. proposed lighting columns ranging from 5 – 12 metres in height, 52 of which are 10 metres high and 70 luminaires replacing the existing 40 No. columns, 29 of which are LED and the remaining 11 No. high-pressure sodium (these lighting poles are associated with the reconfigured Stockbury roundabout – the Stockbury flyover will not be lit);
- Widening of the road corridor;
- Earthworks and structures associated with the Scheme, including associated highways infrastructure, directional signage, variable message signs and concrete retaining walls;
- Additional free-flow links provided for the A249 southbound to M2 westbound and the A249 northbound to M2 eastbound;
- The proposed Maidstone Road Link will be a new road link provided between Stockbury roundabout and Oad Street – with the road link connecting into Oad Street near the existing junction of Oad Street and the A249; and
- Elevated vehicles travelling along the new flyover, with high-sided vehicles using the new flyover would add a further 4 m to the overall visible height of elevated traffic.

9.8.4 Beneficial changes to the landscape and visual receptors during the operational phase would result from the following:

- Closure of the junction between the A249 and South Green Lane, resulting in a more rural feel to the road network, and a central reservation to be provided between this new local-feel road which connects from South Green Lane to Oad Street. The Central reservation will be planted with a hedgerow – creating a physical barrier between the local road and the dual carriageway – with properties no longer fronting directly onto a high-speed road and in keeping with the historic characteristics of highways within the locale;
- Rerouting of PRoW KH85 so that it is further separated from the road by cutting slopes and woodland shaw, thus improving the amenity and experience of this recreational receptor.

9.9 Design, mitigation and enhancement measures

9.9.1 Mitigation has been addressed as part of an iterative design and assessment process. The design and layout have been amended throughout the LVIA process to avoid and reduce impacts of the landscape and visual effects.

9.9.2 The proposed mitigation has focused on the following principles and the guidance in the management documents produced by the Kent Downs AONB (refer to F4 of Appendix F in Volume 2):

- Retain and make best use of existing vegetation;
- Prioritise the early re-establishment of vegetation within the highway boundary;
- Integrate the engineering landform with the adjoining topography;
- Design for maintenance, giving due consideration to the maintenance costs and implications, liabilities and access arrangements for all landscape areas;
- Optimise protection for nearby houses or public areas through use of screening, including vegetative methods;
- Avoid loss or damage to landscape features (e.g. hedges, hedgerows, heritage assets, individual and veteran trees) where possible within the constraints of the design;
- Use native species of local provenance wherever possible; and
- Consider innovative solutions for integrating hard structures into the landscape setting of the M2 J5.

9.9.3 The landscape proposals that form part of the M2 J5 improvements are shown on the Preliminary Environmental Design Plans (see Figure 2.3 in Volume 3).

Construction

9.9.4 Construction phase environmental measures have been developed as part of the iterative design. These have been accounted for in the assessment of effects without mitigation. For landscape and visual matters, the construction phase and associated mitigation refers to the construction compounds, construction activity, machinery and processes to implement the Scheme as set out within the methodology section.

9.9.5 Construction mitigation measures are set out in Table 9.15 below. Specific landscape and visual construction mitigation measures are also described in the OEMP (see Appendix A in Volume 2).

Table 9.15: LVIA construction mitigation measures

ES category	LVIA mitigation measures
Embedded	• Locating the construction compound within the existing Volkerlaser construction site, situated beneath the M2 viaduct, in a relatively hidden position from the wider landscape; this aids in reducing the visibility of these elements from the wider landscape and impact upon agricultural or vegetated land adjoining the A249; • Not locating any construction compounds within the Kent Downs AONB;

ES category	LVIA mitigation measures
	• Ensuring that soil structures are protected where land would be used temporarily, such as for compounds, re-grading areas etc. so that when it is returned to the existing land use, it is in a suitable condition; • Implementation of the OEMP; • Ensuring that valued trees, woodland, existing vegetation and other landscape features are protected and retained wherever possible, in accordance with BS5837:2012. Trees in relation to design, demolition and construction. Recommendations and the Scheme Arboricultural Impact Assessment (see Document: Appendix M in Volume 2); • Stripping, handling and management of soils to be in accordance with DEFRA (2009) Construction Code of Practice for the sustainable use of soils on constructions sites; and • Considerate Construction management.

9.9.6 Due to the short-term and temporary nature of the construction effects identified, it is not considered feasible to include any additional landscape mitigation measures to further reduce the construction phase effects.

Operation

9.9.7 Operational phase environmental measures have been developed as part of the iterative design. These have been accounted for in the assessment of effects without mitigation.

9.9.8 Operation mitigation measures are set out in Table 9.16 below. Specific landscape and visual mitigation measures are also represented on the Preliminary Environmental Design drawings (see Figure 2.3 in Volume 3) and the illustrative cross-section drawings (see Figure 2.4 in Volume 3).

Table 9.16: Operation design, mitigation and enhancement measures

ES category	Design, mitigation and enhancement measures
Embedded	• Access tracks around the infiltration ponds will be further refined at the detailed design stage, these will be either of a grass-crete construction or laid with an unbound compacted type 1 stone, such as limestone chippings or hoggin, as recommended within the Kent Downs AONB Landscape Design Handbook, 2004. Ensuring that soil structures are protected where land would be used temporarily, such as for compounds, re-grading areas etc. so that when it is returned to the existing land use, it is in a suitable condition; • Throughout the Scheme, cutting slopes have been designed to be between 1 in 2.5 and 1 in 3 to ensure that the proposed landscape mitigation planting can be successfully implemented and maintained to establishment; • The alignment of the east bound M2 J5 slip road has been re-designed to tie in earlier to the existing road alignment, this has been to avoid impacts to the veteran trees adjacent to Chestnut Wood so as to retain as much of the existing highways vegetation in this vicinity as possible; • Off-site mitigation in the form of bolstered tree and shrub planting along Church Hill following consultation and advice from the Kent Downs AONB; • The cladding option for the proposed Stockbury flyover retaining walls will be constructed using the Tensar TW1 link wall system with a secondary stone cladding using locally sourced natural stones laid to a local style,

ES category	Design, mitigation and enhancement measures
	current options being explored are the use of Flint, so as to reflect the local vernacular and character of the area; • Fencing for the site is to be timber post and rail – the style and appearance is to be agreed with Highways England and the relevant stakeholders; • Traffic islands around the Stockbury roundabout were shown at Stage 2 as being vegetated with amenity grassland, due to their location adjacent to fast-moving traffic, it was deemed that maintaining these narrow strips would pose an unnecessary risk to maintenance workers, therefore, an alternative solution has been to re-design these areas, so that they are to be paved with locally sourced Kentish Ragstone; • Earthworks have been removed along the southern side of the A249 adjacent to residential properties, so as to retain the important mature tree and shrub belts here, which provides a physical barrier and visual separation from the road; • The Public Right of Way (PRoW) KH85, will be re-routed away from the existing A249 and with a more robust and dense vegetative barrier in the form of woodland belts, views towards the A249 will be reduced and the setting for this section of the PRoW improved; • Drainage ditches have been reduced in width throughout the Scheme from 13 m to 7 m so as to accommodate an increased extent of planting throughout the site; • The aquatic pond adjacent to the Gate House is to be reinstated and re-designed as an ecological pond adjacent to the proposed drainage ditches in this section of grazing land; • Extensive woodland planting adjacent to Church Wood is proposed so as to enhance this Ancient Woodland and to ensure that there is no net loss for this valuable habitat type as a result of the Scheme; • The important hedgerows along Oad Street and adjacent to Honeycrock Hill will be translocated along Oad Street and any remaining gaps will be infilled with hedgerow and tree planting, as well as wildflower understorey and hedgerow trees planted to the back of the translocated hedgerows; • Native and locally appropriate rain garden species have been proposed for within the infiltration ponds, providing bioretention and additional ecological and landscape screening benefits; • Chalk grassland has been proposed on appropriately situated cutting slopes; • A mosaic of habitats have been incorporated into the Scheme, so as to maximise biodiversity benefits; • Fragmented habitats will be re-linked and connectivity restored throughout the entirety of the Scheme; and • Rare orchids will be translocated from impacted RNRs.

Landscape elements

9.9.9 A soft landscape scheme has been designed either side of the entire length of the route (aside from areas where we have sought to retain as much vegetation as is possible, so as to minimise the impacts of the Scheme on the adjoining land). Soft landscape features are considered essential to the Scheme and will form its permanent soft estate. The mitigating effect that the measures designed into the Scheme have on the landscape and views are described in detail in the assessment tables for operational landscape and visual effects, these can be found in the Landscape and Visual Assessment Tables F.12 - F.13 in Appendix F in Volume 2.

9.9.10 Where planting has been proposed, it includes native species reflecting both those currently on-site, yet with regard to recommendations from the Kent Downs AONB design guidance and to regional and local landscape character enhancement suggestions. Native planting is to be of local provenance, as detailed within the Forestry Commission's Practice Note on Using Local Stock for Planting Native Trees and Shrubs.

9.9.11 The Scheme would lead to the approximate loss of the following landscape elements:

- 5.4 hectares of woodland (broad-leaved semi-natural / broad-leaved plantation and mixed plantation woodland);
- 0.75 hectares of scrub (dense/continuous scrub and scattered scrub);
- 4.81 hectares of grassland (poor semi-improved / tall ruderal / marsh/marshy grassland and amenity grassland);
- 12.06 hectares of arable land;
- 1,142 linear metres of hedgerow (intact species-rich / intact species-poor / defunct species-poor / species-rich with trees and species-poor with trees);
- 250 linear metres of dry ditch; and
- 342 m^2 of pond habitats.

9.9.12 As part of the iterative design process, the Preliminary Environmental Design (see Figure 2.3 in Volume 3), is expected to deliver the following in terms of habit creation and restoration, providing approximately:

- 6.09 hectares of woodland;
- 2.63 hectares of scrub;
- 2.86 hectares of calcareous grassland;
- 7.37 hectares of poor semi-improved grassland, tall ruderal and amenity grassland;
- 3,778 linear metres of hedgerow;
- 3,266 linear metres of dry ditch; and
- 392 m^2 of pond habitats.

9.9.13 The landscape and ecological mitigation has been designed so as to restore the landscape elements lost as a result of the Scheme, to integrate the Scheme sensitively within the adjoining landscape, to complement and reinforce the special characteristics of the surrounding landscape, to screen views of the Scheme from sensitive visual receptors, to limit and manage views from the wider landscape, to restore and bolster existing landscape elements, including the reconnection of fragmented landscape elements, and to diversify the range of landscape elements within the area. Furthermore, cladding and hard landscape materials associated with the flyover have been selected to be in keeping with the local vernacular and with due regard to the sensitive setting of the Kent Downs AONB.

9.9.14 As the mitigation measures establish over the operational phase (years 1 to 15), they would fulfil their intended functions in providing screening, landscape integration, amenity and soft estate improvements, leading to a reduction/mitigation of the adverse changes to landscape elements, visual amenity and landscape character resulting from the Scheme. They would lead to a positive change to the condition and quality of the landscape within the Scheme boundary, improving the overall character and diversity of the soft estate of the Scheme within the local landscape setting.

9.10 Assessment of effects

Construction assessment

9.10.1 Construction activities associated with the Scheme would take place over a period of 18 months, commencing in 2020.

9.10.2 For the construction phase, Moderate, Large and Very Large adverse effects are considered to be significant. Slight adverse and neutral effects are considered not significant. These are included in the Landscape and Visual Assessment Tables, see Appendix F Tables F10-F13in Volume 2.

9.10.3 Viewpoint locations are shown on Figures 9.6, 9.7 and 9.14 in Volume 3. Viewpoint photo sheets can be found on Figures 9.15-9.46 in Volume 3 and the Visual effects drawings summarising the assessment, can be found on Figures 9.47 - 9.50 in Volume 3.

Landscape construction effects

9.10.4 Construction activities would be limited to within the Scheme boundary and its immediate surroundings. The construction compound would take the place of the existing Volkerlaser compound located underneath the M2 viaduct. The construction phase would be short-term (18 months) and temporary in nature.

9.10.5 Construction activity, compounds, disturbed ground, security and task lighting, would be apparent at various times throughout the construction phase and at points, different locations along the Scheme. Construction activities such as vegetation clearance, building of structures and significant earth movements, would result in a dynamic and disruptive character to the local landscape during the works. Vegetation clearance associated with the construction phase would lead to increased localised visibility towards the Scheme and would exacerbate the impacts of the construction works.

9.10.6 The permanent loss of vegetation, and its impact on the landscape, is considered in the Landscape Construction Assessment, see Table F.10 of Appendix F in Volume 2 and Table 9.17 below for the summarised residual effects. Disruption from construction effects would be present from views immediately adjacent to the site, which would impact upon outdoor workers, residential receptors and recreational users.

9.10.7 Construction effects would be largely temporary, in part reversible and intermittent throughout the construction phase. Effects that are not reversible would be the permanent loss of vegetation and other alterations to the landscape which are of a permanent/long-term duration i.e. beyond the construction period.

9.10.8 The summary of construction landscape effects is shown in Table 9.17 below and the full assessment is available in Table F.10 of Appendix F in Volume 2.

Table 9.17: Summary of landscape construction effects

Landscape receptor	Receptor sensitivity	Construction impact	Effect at winter during construction year
Regional Landscape Character Areas			
LAK: Bicknor: Mid Kent Downs	Moderate	Moderate Adverse	**Moderate** Adverse and significant
LAK: Chatham Outskirts: Mid Kent Downs	Moderate	Moderate Adverse	**Moderate** Adverse and significant
LAK: Fruit Belt	Low	Moderate Adverse	**Slight** Adverse and not significant
Local Landscape Character Areas			
MBC: Bredhurst and Stockbury Downs	Moderate	Negligible Adverse	**Slight** Adverse and not significant
MBC: Hucking Dry Valleys	High	Moderate Adverse	**Moderate** Adverse and significant
SBC: Borden Mixed Farmlands	Moderate	Negligible Adverse	**Slight** Adverse and not significant
SBC: Newington Arable Farmlands	Moderate	Moderate Adverse	**Moderate** Adverse significant
SBC: Deans Bottom	High	Negligible Adverse	**Slight** Adverse and not significant
SBC: Tunstall Farmlands	Moderate	Moderate Adverse	**Moderate** Adverse and significant

Visual construction effects

9.10.9 The determined value, susceptibility and sensitivity of the visual receptors to changes resulting from the construction of the Scheme were outlined in the baseline for this chapter. The summary of the construction visual effects is listed below in Table 9.18 for visual receptors. The full visual assessment can be found in Table F.11 of Appendix F: Landscape and Visual in Volume 2 and on the Visual effects drawings (Figures 9.47 – 9.50 in Volume 3).

Table 9.18: Summary of visual construction effects

Viewpoint	Receptors represented	Receptor sensitivity	Construction impacts	Effects during construction phase (18 months)
Viewpoint 1	• Transport receptors using Wormdale Hill; and • Transports receptors using the A249 travelling westerly towards the M2 J5.	• Transport receptors using Wormdale Hill: **Low** visual sensitivity; and • Transports receptors using the A249 travelling westerly towards the M2 J5: **Low** visual sensitivity.	• Transport receptors using Wormdale Hill: **Moderate** impact; and • Transports receptors using the A249 travelling westerly towards the M2 J5: **Moderate** impact.	• Transport receptors using Wormdale Hill: **Slight** Adverse and not significant; and • Transports receptors using the A249 travelling westerly towards the M2 J5: **Slight** Adverse and not significant.
Viewpoint 2	• Transport receptors using Maidstone Road travelling southwest towards the M2 J5; and • Residential receptors along the Maidstone Road at Danaway.	• Transport receptors using Maidstone Road travelling southwest towards the M2 J5: **Low** visual sensitivity; and • Residential receptors along the Maidstone Road at Danaway: **High** visual sensitivity.	• Transport receptors using Maidstone Road travelling southwest towards the M2 J5: **Moderate** impact; and • Residential receptors along the Maidstone Road at Danaway: **Moderate** impact.	• Transport receptors using Maidstone Road travelling southwest towards the M2 J5: **Slight** Adverse and not significant; and • Residential receptors along the Maidstone Road at Danaway: **Moderate** Adverse and significant.
Viewpoint 3	• Recreational receptors using the PRoW KH81; • Outdoor employment receptors adjacent to the A249; • The visual amenity of people enjoying the setting of heritage receptors: Grade I listed Church of St Mary Magdalene; and • The visual amenity of people enjoying the setting of heritage receptors: Scheduled Monument –	• Recreational receptors using the PRoW KH81: **High** sensitivity; • Outdoor employment receptors adjacent to the A249: **Moderate** sensitivity; • The visual amenity of people enjoying the setting of Heritage receptors: Grade I listed Church of St Mary Magdalene: **High** sensitivity; and • The visual amenity of people enjoying the setting of heritage receptors: Scheduled Monument –	• Recreational receptors using the PRoW KH81: **Moderate** impact; • Outdoor employment receptors adjacent to the A249: **Moderate**; • The visual amenity of people enjoying the setting of heritage receptors: Grade I listed Church of St Mary Magdalene: **No change**; and • The visual amenity of people enjoying the setting of heritage receptors: Scheduled Monument –	• Recreational receptors using the PRoW KH81: **Large** Adverse and significant; • Outdoor employment receptors adjacent to the A249: **Moderate** Adverse and significant; • The visual amenity of people enjoying the setting of heritage receptors: Grade I listed Church of St Mary Magdalene: **Neutral**; and • The visual amenity of people enjoying the setting of heritage receptors: Scheduled Monument.– ringwork and

Viewpoint	Receptors represented	Receptor sensitivity	Construction impacts	Effects during construction phase (18 months)
	ringwork and baileys adjacent to Church Lane.	ringwork and baileys adjacent to Church Lane: **High** sensitivity.	ringwork and baileys adjacent to Church Lane: **No change**.	baileys adjacent to Church Lane: **Neutral**.
Viewpoint 4	• Residential receptors: Milton Bungalow and Bowl Reed along Oad Street, in proximity to the proposed Maidstone Road Link.	• Residential receptors: Milton Bungalow and Bowl Reed along Oad Street, in proximity to the proposed Maidstone Road Link: **High** sensitivity.	• Residential receptors: Milton Bungalow and Bowl Reed along Oad Street, in proximity to the proposed Maidstone Road Link: **Moderate** impact.	• Residential receptors: Milton Bungalow and Bowl Reed along Oad Street, in proximity to the proposed Maidstone Road Link: **Moderate** Adverse and significant.
Viewpoint 5	• Transport receptors using the Oad Street overpass.	• Transport receptors using the Oad Street overpass: **Low** sensitivity.	• Transport receptors using the Oad Street overpass: **Moderate** impact.	• Transport receptors using the Oad Street overpass: **Slight** Adverse and not significant.
Viewpoint 6	• Residential receptor: Whipstakes Farm, Oad Street; and • Transport receptors travelling along Oad Street.	• Residential receptor: Whipstakes Farm, Oad Street: **High** sensitivity; and • Transport receptors travelling along Oad Street: **Moderate** sensitivity.	• Residential receptor: Whipstakes Farm, Oad Street: **Moderate** impact; and • Transport receptors travelling along Oad Street: **Moderate** impact.	• Residential receptor: Whipstakes Farm, Oad Street: **Moderate** Adverse and significant; and • Transport receptors travelling along Oad Street: **Moderate** Adverse and significant.
Viewpoint 7	• Recreational receptors: PRoW ZR70.	• Recreational receptors: PRoW ZR70: **Moderate** sensitivity.	• Recreational receptors: PRoW ZR70: **Moderate** impact.	• Recreational receptors: PRoW ZR70: **Moderate** Adverse and significant.
Viewpoint 8 (Swale Borough Council – Additional Viewpoint 6)	• Recreational receptor: PRoW KH85; and • Outdoor employment receptors adjacent to the A249.	• Recreational receptor: PRoW KH85: **Moderate** sensitivity; and • Outdoor employment receptors adjacent to the A249: **Moderate** sensitivity.	• Recreational receptor: PRoW KH85: **Major** impact; and • Outdoor employment receptors adjacent to the A249: **Major** impact.	• Recreational receptor: PRoW KH85: **Large** Adverse and significant; and • Outdoor employment receptors adjacent to the A249: **Large** Adverse and significant.
Viewpoint 9	• Recreational receptor: PRoW KH85; and	• Recreational receptor: PRoW KH85: **Moderate** sensitivity; and	• Recreational receptor: PRoW KH85: **Major** impact; and	• Recreational receptor: PRoW KH85: **Large** Adverse and significant; and

Viewpoint	Receptors represented	Receptor sensitivity	Construction impacts	Effects during construction phase (18 months)
	• Outdoor employment receptors adjacent to the A249.	• Outdoor employment receptors adjacent to the A249: **Moderate** sensitivity.	• Outdoor employment receptors adjacent to the A249: **Major** impact.	• Outdoor employment receptors adjacent to the A249: **Large** Adverse and significant.
Viewpoint 10 (Kent Downs AONB – Additional viewpoint 1)	• Recreational receptor: PRoW ZR135; and • Outdoor employment receptors adjacent to the M2 corridor.	• Recreational receptor: PRoW ZR135: **High** visual sensitivity; and • Outdoor employment receptors adjacent to the M2 corridor: **Moderate** visual sensitivity.	• Recreational receptor: PRoW ZR135: **Negligible** impact; and • Outdoor employment receptors adjacent to the M2 corridor: **Negligible** impact.	• Recreational receptor: PRoW ZR135: **Slight** Adverse and not significant; and • Outdoor employment receptors adjacent to the M2 corridor: **Neutral**.
Viewpoint 11 (Kent Downs AONB – Additional viewpoint 2)	• Recreational receptor: PRoW KH85; and • Outdoor employment receptors adjacent to the A249.	• Recreational receptor: PRoW KH85: **Moderate** visual sensitivity; and • Outdoor employment receptors adjacent to the A249: **Moderate** visual sensitivity.	• Recreational receptor: PRoW KH85: **Major** impact; and • Outdoor employment receptors adjacent to the A249: **Major** impact.	• Recreational receptor: PRoW KH85: **Large** Adverse and significant; and • Outdoor employment receptors adjacent to the A249: **Large** Adverse and significant.
Viewpoint 12	• Recreational receptor: PRoW ZR71; and • Outdoor employment receptors adjacent to the A249.	• Recreational receptor: PRoW ZR71: **Moderate** visual sensitivity; and • Outdoor employment receptors adjacent to the A249: **Moderate** visual sensitivity.	• Recreational receptor: PRoW ZR71: **Major** impact; and • Outdoor employment receptors adjacent to the A249: **Major** impact.	• Recreational receptor: PRoW ZR71: **Large** Adverse and significant; and • Outdoor employment receptors adjacent to the A249: **Large** Adverse and significant.
Viewpoint 13	• Residential receptors adjacent to the A249; and • Transport receptors travelling along the A249.	• Residential receptors adjacent to the A249: **High** visual sensitivity; and • Transport receptors travelling along the A249: **Low** visual sensitivity.	• Residential receptors adjacent to the A249: **Major** impact; and • Transport receptors travelling along the A249: **Major** impact.	• Residential receptors adjacent to the A249: **Large** Adverse and significant; and • Transport receptors travelling along the A249: **Moderate** Adverse and significant.

Viewpoint	Receptors represented	Receptor sensitivity	Construction impacts	Effects during construction phase (18 months)
Viewpoint 14	• Residential receptors at Norton Green; • Recreational receptor: PRoW KH80; and • Outdoor employment receptors at Norton Green.	• Residential receptors at Norton Green: **High** visual sensitivity; • Recreational receptor: PRoW KH80: **High** visual sensitivity; and • Outdoor employment receptors at Norton Green: **Moderate** visual sensitivity.	• Residential receptors at Norton Green: **Minor** impact; • Recreational receptor: PRoW KH80: **Minor** impact; and • Outdoor employment receptors at Norton Green: **Minor** impact.	• Residential receptors at Norton Green: **Moderate** Adverse and significant; • Recreational receptor: PRoW KH80: **Moderate** Adverse and significant; and • Outdoor employment receptors at Norton Green: **Slight** Adverse and not significant.
Viewpoint 15	• Residential receptor at Hillside Farm; • Recreational receptor: PRoW KH80; and • Outdoor employment receptors at Hillside Farm.	• Residential receptor at Hillside Farm: **High** visual sensitivity; • Recreational receptor: PRoW KH80: **High** visual sensitivity; and • Outdoor employment receptors at Hillside Farm: **Moderate** visual sensitivity.	• Residential receptor at Hillside Farm: **Moderate** impact; • Recreational receptor: PRoW KH80: **Moderate** impact; and • Outdoor employment receptors at Hillside Farm: **Moderate** impact.	• Residential receptor at Hillside Farm: **Moderate** Adverse and significant; • Recreational receptor: PRoW KH80: **Moderate** Adverse and significant; and • Outdoor employment receptors at Hillside Farm: **Moderate** Adverse and significant. •
Viewpoint 16	• Residential receptors adjacent to the A249: Hinecom, Sandina, Valley View Farm and White House; • Transport receptors travelling along the A249; and • Outdoor employment receptors fronting onto the A249.	• Residential receptors adjacent to the A249: Hinecom, Sandina, Valley View Farm and White House: **High** visual sensitivity; • Transport receptors travelling along the A249: **Low** visual sensitivity; and • Outdoor employment receptors fronting onto the A249: **Moderate** visual sensitivity.	• Residential receptors adjacent to the A249: Hinecom, Sandina, Valley View Farm and White House: **Moderate** impact; • Transport receptors travelling along the A249: **Moderate** impact; and • Outdoor employment receptors fronting onto the A249: **Moderate** impact.	• Residential receptors adjacent to the A249: Hinecom, Sandina, Valley View Farm and White House: **Moderate** Adverse and significant; • Transport receptors travelling along the A249: **Slight** Adverse and not significant; and • Outdoor employment receptors fronting onto the A249: **Moderate** Adverse and significant.

Operation assessment

9.10.10 The operational phase assessment considers the medium- and long-term effects of the Scheme, from the end of the construction period to the fifteenth year of operation, whilst the proposed landscape and ecological mitigation is establishing.

9.10.11 Landscape mitigation measures were developed as part of an iterative design process, with opportunities identified and developed to reduce the adverse effects and to ensure that the Scheme is better situated into the landscape setting. These mitigation measures are integral to the Scheme. The landscape and ecological mitigation measures are shown on the Preliminary Environmental Design Plans (see Figure 2.3 in Volume 3 and described in Section 9.9).

Landscape operational effects

Landform and geology

9.10.12 The Scheme would largely follow the gently undulating topography of the receiving landscape, with the Scheme in cutting where necessary to accommodate the works. However, where the Scheme is in cutting, this would dually assist in limiting views towards the Scheme and would provide a secondary screening function. The Maidstone Road Link would disrupt the topography of the dip slope valley of which it will ascend, established mitigation planting will serve to integrate the road, but would remain as a new urbanising feature within the landscape.

Recreation and access

9.10.13 Those PRoWs identified as being impacted, would be permanently re-routed and better situated away from the A249, both physically and visually, as a result of the established mitigation planting in the form of woodland belts and hedgerows.

Ancient Woodland

9.10.14 Ancient Woodland at Church Wood (to the northwest of the Scheme) would not be directly impacted by the Scheme. There would however, be peripheral views from the eastern edge of the woodland towards the Scheme, with elevated views towards the Stockbury flyover, which would increase the extent of urbanising features within the view, as well as an increased presence of elevated traffic. In terms of mitigation, the woodland will be connected up to the extended and strengthened field boundary vegetation, providing a vital green corridor and strengthening the value of the woodland. Furthermore, wildflower understoreys to proposed adjacent woodland – would further serve to improve the woodland's amenity and biodiversity value.

9.10.15 Ancient Woodland at Chestnut Wood (to the east-southeast of the Scheme), would not be directly impacted by the Scheme. As part of the mitigation design, veteran trees adjacent to this woodland, and adjoining mature highways vegetation, are to be retained. There may be filtered views within the woodland towards the proposed Stockbury flyover and of the lighting poles in the vicinity of the Stockbury roundabout, however, retained highways vegetation and additional woodland belt planting adjacent to the highways would assist in screening views towards the Scheme. Additional woodland belt planting within the grazing field

adjacent to the Ancient Woodland and the infilling of fragmented hedgerows, ultimately connecting up to the woodland, will serve to restore the ecological corridors within this section of land, thus ultimately enhancing the value of the woodland.

Character of the night sky

9.10.16 As a result of the Scheme, there is likely to be an increase in lighting in localised areas adjacent to the A249 and in particular within the vicinity of the Stockbury roundabout adjacent to the Stockbury flyover. This area already experiences moderate levels of brightness/light and due to the increased extent of lighting poles adjacent to the Stockbury roundabout and the presence of elevated traffic travelling along the Stockbury flyover, there is likely to be additional exacerbation and disturbance. There may also be some light pollution seen in the distance from elevated viewpoints at Norton Green towards the Scheme, however, these impacts would likely be very minor/negligible given the distance of the receptor from the source. The intervening vegetation and landform of the surrounding landscape would limit impacts on the wider landscape.

9.10.17 However, it should be noted that due to the use of LED lighting and directional fittings, this will likely limit the degree of light spill on surrounding receptors and serve to reduce the overall impacts resulting from the increase in the extent and number of lighting columns.

9.10.18 Residential properties in proximity to the Scheme with views of the Scheme would likely experience visual intrusion and disturbance as a result of the lighting associated with the Stockbury flyover (the flyover itself will be unlit, but there will be visibility from the headlamps of elevated traffic travelling along the flyover), Stockbury roundabout (lighting poles), and the proposed Maidstone Road Link (traffic travelling along the Road Link), with particular adverse impacts experienced by Whipstakes Farm and Milton Bungalow.

9.10.19 The majority of the study area is green, at a light level of 1-2 and this categorisation is likely to largely remain the same away from the Scheme, due to the containment of the A249 and M2 within the bottom of the dry valley and the fact that the A249 is unlit beyond the Stockbury roundabout.

Tranquillity

9.10.20 As a result of the Scheme, there is likely to be a reduction in the levels of tranquillity experienced immediately adjacent to the proposed Stockbury flyover, the proposed Maidstone Road, and areas of the A249 which have been widened as part of the Scheme. At present, the wider landscape experiences a range in levels from low levels of tranquillity (red) adjacent to the transport corridors and to the north of the M2 viaduct, to moderate levels of tranquillity (yellow) found elsewhere. Due to the nature of the Scheme being so well-contained within the dry valley base – this will limit impacts upon the wider landscape and the moderate levels of tranquillity experienced elsewhere will remain largely the same.

Landscape character

9.10.21 The value, susceptibility and sensitivity of the landscape receptors to changes brought about by the development of the type proposed, was determined as part

of the baseline assessment. Table 9.19 below summarises the residual effects on each character area. The full assessment can be found in Table F.12 of Appendix F in Volume 2.

Table 9.19: Summary of landscape operational effects

Landscape receptor	Receptor sensitivity	Operational impact	Operational effects at winter year 1	Mitigation and magnitude of impact at summer year 15	Significance of residual effects at operation year 15
Regional Landscape Character Areas					
LAK: Bicknor: Mid Kent Downs	Moderate	Moderate Adverse.	**Moderate** Adverse and significant	Localised impacts would be reduced sufficiently enough to reclassify the magnitude of impact. down to Minor Adverse.	**Slight** Adverse and not significant
LAK: Chatham Outskirts: Mid Kent Downs	Moderate	Moderate Adverse.	**Moderate** Adverse and significant	The adverse magnitude of impact would be reduced down to Minor Adverse.	**Slight** Adverse and not significant
LAK: Fruit Belt	Low	Moderate Adverse.	**Slight** Adverse and not significant	The adverse magnitude of impact would be reduced down to Minor Adverse.	Neutral
Local Landscape Character Areas					
MBC: Bredhurst and Stockbury Downs	Moderate	Negligible Adverse.	Neutral	The adverse magnitude of impact would be reduced to Negligible Adverse.	Neutral
MBC: Hucking Dry Valleys	High	Moderate Adverse.	**Moderate** Adverse and significant	The adverse magnitude of impact would be reduced down to Minor Adverse.	**Slight** Adverse and not significant
SBC: Borden Mixed Farmlands	Moderate	Minor Adverse.	**Slight** Adverse and not significant	The adverse magnitude of impact would be reduced to Negligible Adverse.	Neutral
SBC: Newington Arable Farmlands	Moderate	Moderate Adverse**.**	**Moderate** Adverse and significant	The adverse magnitude of impact would be reduced down to Minor Adverse.	**Slight** Adverse and not significant
SBC: Deans Bottom	High	Minor Adverse.	**Slight** Adverse and not significant	The adverse magnitude of impact would be reduced to Negligible Adverse.	**Slight** Adverse and not significant

Landscape receptor	Receptor sensitivity	Operational impact	Operational effects at winter year 1	Mitigation and magnitude of impact at summer year 15	Significance of residual effects at operation year 15
SBC: Tunstall Farmlands	Moderate	Minor Adverse.	**Moderate** Adverse and significant	The adverse magnitude of impact would be reduced slightly to Minor Adverse.	**Slight** Adverse and not significant

Visual operational effects

9.10.22 The summary of residual effects on visual receptors are presented in in Table 9.20 below. The full visual assessment, including operational effects at year 1, can be found in Table F.13 of Appendix F in Volume 2.

9.10.23 Viewpoint locations are shown on Figures 9.7 and 9.14 in Volume 3. Viewpoint photo sheets are shown on Figures 9.15-9.46 in Volume 3 and the Visual effects drawings summarising the assessment can be found on Figures 9.47-9.50 in Volume 3. A number of supplementary photomontages to convey the Scheme and the progressive establishment of mitigation planting between years 1, 5 and 15 are provided on Figures 9.51-9.59 in Volume 3.

Effects on residential receptors

9.10.24 Following the visual assessment of the operational phase, the following residential receptors were assessed as experiencing significant effects/changes to their views as a result of the Scheme:

- Residential receptors adjacent to the A249: Hinecom, Sandina, Valley View Farm and White House (VP16) would experience **Moderate** Adverse and significant effects at operation year 1, however, after the establishment of mitigation planting, there will be no significant effects to these residential receptors by year 15;
- Residential receptors at Norton Green (VP 14) would experience **Moderate** Adverse and significant effects at operation year 1, and **Slight** Adverse and not significant effects at operation year 15;
- Residential receptors along the Maidstone Road at Danaway (VP2) would have a **Moderate** Adverse and significant effect at operation year 1, after mitigation planting has established, at operation year 15, these effects will have been reduced to **Slight** Adverse and not significant;
- Residential receptors at Hillside Farm (VP 15) would experience **Moderate** Adverse and significant effects during operation year 1, with the establishment of mitigation planting leading to a reduction in category to **Slight** Adverse and not significant effects in year 15;
- Residential receptors at Whipstakes Farm, Oad Street (VP 6) would experience **Moderate** Adverse significant effects during operation year 1, even with the establishment of mitigation planting, it is deemed that effects would not be reduced below **Moderate** Adverse and significant at year 15;
- Residential receptors at Milton Bungalow and Bowl Reed along Oad Street (VP 4) would experience **Moderate** Adverse and significant effects at operation year 1, with the establishment of mitigation planting in conjunction with the screening measures provided by existing vegetation and ancillary buildings, leading to a reduction in category to **Slight** Adverse and not significant effects at year 15; and
- Given the nature of the existing view of the residential receptors adjacent to the A249 (VP 13) (e.g. direct views across the A249), these receptors would experience **Moderate** Adverse and significant effects at operation year 1, reducing to **Slight** Adverse and not significant at operation year 15, as a

result of the establishment of mitigation planting and the physical separation provided by the new local road scenario outside of these properties and the physical barrier provided by the woodland belt planting between this road and the widened A249.

Effects on recreational receptors

9.10.25 Following the visual assessment of the operational phase, the following recreational receptors were assessed as experiencing significant effects/changes to their views as a result of the Scheme:

- Recreational receptors: PRoW KH80 (VP 15) would experience **Moderate** Adverse and significant effects at operation year 1, however, after the establishment of mitigation planting these would reduce to **Slight** Adverse and not significant effects at year 15;
- Recreational receptors: PRoW KH80 (VP 14) would experience **Moderate** Adverse and significant effects at operation year 1, however, after the establishment of mitigation planting there will be a reduction in category to **Slight** Adverse and not significant effects at year 15;
- Recreational receptors: PRoW ZR70 (VP 7) and PRoW ZR135 would experience **Slight** Adverse and not significant effects at operation year 1, by operation year 15, the maturation of the mitigation planting will further aid in integrating the Scheme into their view, reducing effects to **Neutral**;
- Recreational receptors: PRoW ZR71 (VP 12) would experience **Moderate** Adverse and significant effects at operation year 1, reducing to **Slight** Adverse and not significant effects at year 15 as a result of the establishment of mitigation planting;
- Recreational receptors: PRoW KH81 (VP 3) would experience **Moderate** Adverse and significant effects at operation year 1, however, following the establishment of mitigation planting these would reduce in category to **Slight** Adverse and not significant effects at year 15;
- Recreational receptors: PRoW KH85 (VP 8 / VP 9) would experience **Large** Adverse and significant effects at operation year 1, however, at operation year 15 due to the establishment of mitigation planting, screening views towards the Scheme, there would be a substantial reduction in impact, with effects substantially reducing to **Slight** Adverse and not significant;
- Recreational receptors: PRoW ZR135 (VP 10) would experience **Slight** Adverse and not significant effects at operation year 1 and operation year 15; and
- Recreational receptors: PRoW KH85 (VP 11) would experience **Large** Adverse and significant effects at operation year 1, reducing substantially to **Slight** Adverse and not significant as a result of the establishment of mitigation planting by year 15.

Effects on transport receptors

9.10.26 Following the visual assessment of the operational phase, the following transport receptors were assessed as experiencing significant effects/changes to their

views as a result of the Scheme:

- Transport receptors travelling along Oad Street (VP 6) and transport receptors travelling along the A249 (VP 13) would experience **Moderate** Adverse and significant effects at operation year 1, and as a result of the establishment of mitigation planting, would reduce to **Slight** Adverse and not significant effects at operation year 15.

Effects on employment receptors

9.10.27 Following the visual assessment of the operational phase, the following outdoor employment receptors were assessed as experiencing significant effects/changes to their views as a result of the Scheme:

- Outdoor employment receptors adjacent to the A249 (VP 3), at Hillside Farm (VP 15) and fronting onto the A249 (VP 16), would experience **Moderate** Adverse and significant effects in operation year 1 with these effects reducing to **Neutral** and/or **Slight** Adverse and no significant effects at year 15, depending on their location, due to the establishment of mitigation planting;
- Outdoor employment receptors adjacent to the A249 (VP 12) would experience **Moderate** Adverse and significant effects at operation year 1, reducing in category to **Slight** Adverse and not significant at operation year 15, due to the establishment of mitigation planting;
- Outdoor employment receptors adjacent to the A249 (at VP 8 and VP 9) would experience **Large** Adverse and significant effects at operation year 1, substantially reducing to **Slight** Adverse **and not** significant at operation year 15 resulting from the establishment of mitigation planting; and
- Outdoor employment receptors adjacent to the A249 (VP 11) would experience **Large** Adverse and significant effects at operation year 1, reducing to **Slight** Adverse and not significant at operation year 15 resulting from the establishment of mitigation planting.

Heritage receptors

9.10.28 Following consultation with the Kent Downs AONB on the 8th of January 2018, additional screening measures were incorporated into the Scheme design along the field boundary adjacent to Church Hill, in the form of a woodland belt, so as to provide additional screening to this area and to bolster the existing fragmented tree and shrub belt.

Table 9.20: Summary of visual operational effects (year 15)

Viewpoint	Receptors represented	Receptor sensitivity	Mitigation and magnitude of impact at summer year 15	Residual effect
Viewpoint 1	• Transport receptors using Wormdale Hill; and • Transports receptors using the A249 travelling westerly towards the M2 J5.	• Transport receptors using Wormdale Hill: **Low** visual sensitivity; and • Transports receptors using the A249 travelling westerly towards the M2 J5: **Low** visual sensitivity.	• Transport receptors using Wormdale Hill: **Minor** impact; and • Transports receptors using the A249 travelling westerly towards the M2 J5: **Minor** impact.	• Transport receptors using Wormdale Hill: **Neutral**; and • Transports receptors using the A249 travelling westerly towards the M2 J5: **Neutral**.
Viewpoint 2	• Transport receptors using Maidstone Road travelling southwest towards the M2 J5; and • Residential receptors along the Maidstone Road at Danaway.	• Transport receptors using Maidstone Road travelling southwest towards the M2 J5: **Low** visual sensitivity; and • Residential receptors along the Maidstone Road at Danaway: **High** visual sensitivity.	• Transport receptors using Maidstone Road travelling southwest towards the M2 J5: **Minor** impact; and • Residential receptors along the Maidstone Road at Danaway: **Minor** impact.	• Transport receptors using Maidstone Road travelling southwest towards the M2 J5: **Neutral**; and • Residential receptors along the Maidstone Road at Danaway: **Slight** Adverse and not significant.
Viewpoint 3	• Recreational receptors using the PRoW KH81; • Outdoor employment receptors adjacent to the A249; • The visual amenity of people enjoying the setting of the heritage receptors: Grade I listed Church of St Mary Magdalene; and • The visual amenity of people enjoying the setting of the heritage receptors: Scheduled Monument –	• Recreational receptors using the PRoW KH81: **High** sensitivity; • Outdoor employment receptors adjacent to the A249: **Moderate** sensitivity; • The visual amenity of people enjoying the setting of the heritage receptors: Grade I listed Church of St Mary Magdalene: **High** sensitivity; and • The visual amenity of people enjoying the setting of the heritage receptors: Scheduled Monument –	• Recreational receptors using the PRoW KH81: **Negligible** impact; • Outdoor employment receptors adjacent to the A249: **Negligible** impact; • The visual amenity of people enjoying the setting of the heritage receptors: Grade I listed Church of St Mary Magdalene: **No change**; and • The visual amenity of people enjoying the setting of the heritage receptors: Scheduled Monument – ringwork and baileys adjacent to Church Lane: **No change**.	• Recreational receptors using the PRoW KH81: **Slight** Adverse and not significant; • Outdoor employment receptors adjacent to the A249: **Neutral**; • The visual amenity of people enjoying the setting of the heritage receptors: Grade I listed Church of St Mary Magdalene: **Neutral**; and • The visual amenity of people enjoying the setting of the heritage

Viewpoint	Receptors represented	Receptor sensitivity	Mitigation and magnitude of impact at summer year 15	Residual effect
	ringwork and baileys adjacent to Church Lane.	ringwork and baileys adjacent to Church Lane: **High** sensitivity.		receptors: Scheduled Monument – ringwork and baileys adjacent to Church Lane: **Neutral**.
Viewpoint 4	• Residential receptors: Milton Bungalow and Bowl Reed along Oad Street, in proximity to the proposed Maidstone Road Link.	• Residential receptors: Milton Bungalow and Bowl Reed along Oad Street, in proximity to the proposed Maidstone Road Link: **High** sensitivity.	• Residential receptors: Milton Bungalow and Bowl Reed along Oad Street, in proximity to the proposed Maidstone Road Link: **Minor** impact.	• Residential receptors: Milton Bungalow and Bowl Reed along Oad Street, in proximity to the proposed Maidstone Road Link: **Slight** Adverse and not significant.
Viewpoint 5	• Transport receptors using the Oad Street overpass.	• Transport receptors using the Oad Street overpass: **Low** sensitivity.	• Transport receptors using the Oad Street overpass: **Moderate** impact.	• Transport receptors using the Oad Street overpass: **Slight** Adverse and not significant.
Viewpoint 6	• Residential receptor: Whipstakes Farm, Oad Street; and • Transport receptors travelling along Oad Street.	• Residential receptor: Whipstakes Farm, Oad Street: **High** sensitivity; and • Transport receptors travelling along Oad Street: **Moderate** sensitivity.	• Residential receptor: Whipstakes Farm, Oad Street: **Moderate** impact; and • Transport receptors travelling along Oad Street: **Minor** impact.	• Residential receptor: Whipstakes Farm, Oad Street: **Moderate** Adverse and significant; and • Transport receptors travelling along Oad Street: **Slight** Adverse and not significant.
Viewpoint 7	• Recreational receptors: PRoW ZR70.	• Recreational receptors: PRoW ZR70: **Moderate** sensitivity.	• Recreational receptors: PRoW ZR70: **Negligible** impact.	• Recreational receptors: PRoW ZR70: **Neutral**.
Viewpoint 8 (Swale Borough Council – Additional Viewpoint 6)	• Recreational receptor: PRoW KH85; and • Outdoor employment receptors adjacent to the A249.	• Recreational receptor: PRoW KH85: **Moderate** sensitivity; and • Outdoor employment receptors adjacent to the A249: **Moderate** sensitivity.	• Recreational receptor: PRoW KH85: **Minor** impact; and • Outdoor employment receptors adjacent to the A249: **Minor** impact.	• Recreational receptor: PRoW KH85: **Slight** Adverse and not significant; and • Outdoor employment receptors adjacent to the

Viewpoint	Receptors represented	Receptor sensitivity	Mitigation and magnitude of impact at summer year 15	Residual effect
				A249: **Slight** Adverse and not significant.
Viewpoint 9	• Recreational receptor: PRoW KH85; and • Outdoor employment receptors adjacent to the A249.	• Recreational receptor: PRoW KH85: **Moderate** sensitivity; and • Outdoor employment receptors adjacent to the A249: **Moderate** sensitivity.	• Recreational receptor: PRoW KH85: **Minor** impact; and • Outdoor employment receptors adjacent to the A249: **Minor** impact.	• Recreational receptor: PRoW KH85: **Slight** Adverse and not significant; and • Outdoor employment receptors adjacent to the A249: **Slight** Adverse and not significant.
Viewpoint 10 (Kent Downs AONB – Additional viewpoint 1)	• Recreational receptor: PRoW ZR135; and • Outdoor employment receptors adjacent to the M2 corridor.	• Recreational receptor: PRoW ZR135: **High** visual sensitivity; and • Outdoor employment receptors adjacent to the M2 corridor: **Moderate** visual sensitivity.	• Recreational receptor: PRoW ZR135: **Negligible** impact; and • Outdoor employment receptors adjacent to the M2 corridor: **Negligible** impact.	• Recreational receptor: PRoW ZR135: **Slight** Adverse and not significant; and • Outdoor employment receptors adjacent to the M2 corridor: **Neutral**.
Viewpoint 11 (Kent Downs AONB – Additional viewpoint 2)	• Recreational receptor: PRoW KH85; and • Outdoor employment receptors adjacent to the A249.	• Recreational receptor: PRoW KH85: **Moderate** visual sensitivity; and • Outdoor employment receptors adjacent to the A249: **Moderate** visual sensitivity.	• Recreational receptor: PRoW KH85: **Minor** impact; and • Outdoor employment receptors adjacent to the A249: **Minor** impact.	• Recreational receptor: PRoW KH85: **Slight** Adverse and not significant; and • Outdoor employment receptors adjacent to the A249: **Slight** Adverse and not significant.
Viewpoint 12	• Recreational receptor: PRoW ZR71; and • Outdoor employment receptors adjacent to the A249.	• Recreational receptor: PRoW ZR71: **Moderate** visual sensitivity; and • Outdoor employment receptors adjacent to the A249: **Moderate** visual sensitivity.	• Recreational receptor: PRoW ZR71: **Minor** impact; and • Outdoor employment receptors adjacent to the A249: **Minor** impact.	• Recreational receptor: PRoW ZR71: **Slight** Adverse and not significant; and • Outdoor employment receptors adjacent to the

Viewpoint	Receptors represented	Receptor sensitivity	Mitigation and magnitude of impact at summer year 15	Residual effect
				A249: **Slight** Adverse and not significant.
Viewpoint 13	• Residential receptors adjacent to the A249; and • Transport receptors travelling along the A249.	• Residential receptors adjacent to the A249: **High** visual sensitivity; and • Transport receptors travelling along the A249: **Low** visual sensitivity.	• Residential receptors adjacent to the A249: **Minor** impact; and • Transport receptors travelling along the A249: **Minor** impact.	• Residential receptors adjacent to the A249: **Slight** Adverse and not significant; and • Transport receptors travelling along the A249: **Neutral**.
Viewpoint 14	• Residential receptors at Norton Green; • Recreational receptor: PRoW KH80; and • Outdoor employment receptors at Norton Green.	• Residential receptors at Norton Green: **High** visual sensitivity; • Recreational receptor: PRoW KH80: **High** visual sensitivity; and • Outdoor employment receptors at Norton Green: **Moderate** visual sensitivity.	• Residential receptors at Norton Green: **Negligible** impact; • Recreational receptor: PRoW KH80: **Negligible** impact; and • Outdoor employment receptors at Norton Green: **Negligible** impact.	• Residential receptors at Norton Green: **Slight** Adverse and not significant; • Recreational receptor: PRoW KH80: **Slight** Adverse and significant; and • Outdoor employment receptors at Norton Green: **Neutral** and not significant.
Viewpoint 15	• Residential receptor at Hillside Farm; • Recreational receptor: PRoW KH80; and • Outdoor employment receptors at Hillside Farm.	• Residential receptor at Hillside Farm: **High** visual sensitivity; • Recreational receptor: PRoW KH80: **High** visual sensitivity; and • Outdoor employment receptors at Hillside Farm: **Moderate** visual sensitivity.	• Residential receptor at Hillside Farm: **Minor** impact; • Recreational receptor: PRoW KH80: **Minor** impact; and • Outdoor employment receptors at Hillside Farm: **Minor** impact.	• Residential receptor at Hillside Farm: **Slight** Adverse and not significant; • Recreational receptor: PRoW KH80: **Slight** Adverse and not significant; and • Outdoor employment receptors at Hillside Farm: **Slight** Adverse and not significant.

Viewpoint	Receptors represented	Receptor sensitivity	Mitigation and magnitude of impact at summer year 15	Residual effect
Viewpoint 16	• Residential receptors adjacent to the A249: Hinecom, Sandina, Valley View Farm and White House; • Transport receptors travelling along the A249; and • Outdoor employment receptors fronting onto the A249.	• Residential receptors adjacent to the A249: Hinecom, Sandina, Valley View Farm and White House: **High** visual sensitivity; • Transport receptors travelling along the A249: **Low** visual sensitivity; and • Outdoor employment receptors fronting onto the A249: **Moderate** visual sensitivity.	• Residential receptors adjacent to the A249: Hinecom, Sandina, Valley View Farm and White House: **Negligible** impact; • Transport receptors travelling along the A249: **Minor** impact; and • Outdoor employment receptors fronting onto the A249: **Minor** impact.	• Residential receptors adjacent to the A249: Hinecom, Sandina, Valley View Farm and White House: **Slight** Adverse and not significant; • Transport receptors travelling along the A249: **Slight** Adverse and not significant; and • Outdoor employment receptors fronting onto the A249: **Slight** Adverse and not significant.

Residual effects

9.10.29 Residual effects have been defined as those environmental effects predicted to remain after the application and establishment of any necessary mitigation and achieving its design objectives at 15 years. Significant effects are those that have an irreversible effect and that cannot be altered once operational during this timeframe.

9.10.30 Table 9.21 below provides a summary of the residual landscape effects (note there are no significant effects associated with the LCAs relevant to the Scheme).

Table 9.21: Summary of residual landscape effects

Landscape receptor	Receptor sensitivity	Magnitude of impact at summer year 15	Significance of residual effects at operation year 15
LAK: Bicknor: Mid Kent Downs	Moderate	Minor Adverse	**Slight** Adverse and not significant
LAK: Chatham Outskirts: Mid Kent Downs	Moderate	Minor Adverse	**Slight** Adverse and not significant
MBC: Hucking Dry Valleys	High	Minor Adverse	**Slight** Adverse and not significant
SBC: Newington Arable Farmlands	Moderate	Minor Adverse	**Slight** Adverse and not significant
SBC: Deans Bottom	High	Negligible Adverse	**Slight** Adverse and not significant
SBC: Tunstall Farmlands	Moderate	Minor Adverse	**Slight** Adverse and not significant

9.10.31 Table 9.22 provides a summary of the significant residual visual effects at year 15.

Table 9.22: Summary of residual visual effects

Viewpoint	Receptors represented	Receptor sensitivity	Magnitude of impact at summer year 15	Significance of residual effects at operation year 15
Viewpoint 6	Residential receptor: Whipstakes Farm, Oad Street.	High	Moderate	**Moderate** Adverse and significant

9.11 Cumulative effects

9.11.1 The criteria for the selection of the four developments to be included in the cumulative assessment are set out in Chapter 15. See Table F.14 of Appendix F in Volume 2 for a consideration of the effects/additional changes arising from the Scheme in conjunction with the selected proposed developments within and adjacent to the study area. Two of the proposed developments have a planning status of ‘permitted but not yet implemented’ and these developments are within

200 m of the Scheme boundary to the north-northeast of the Scheme (see Figure 15.2 in Volume 3), the other two developments considered as part of the cumulative assessment are located within 3 km of the Scheme and have a planning status of 'submitted but not yet determined'.

9.11.2 There would be no degree of cumulative inter-visibility between the proposed developments and the Scheme, however, in the short-term, significant localised effects on the local/regional landscape character would arise as a result of the introduction of additional urbanising features into the landscape and the extension of the urban edge of Sittingbourne into the rural landscape. Once the landscape and ecological proposals associated with the developments have established, these measures will aid in successfully integrating these developments into the rural landscape. However, rural areas will remain vulnerable to further future coalescence and landscape degradation.

9.12 Monitoring

9.12.1 The Contractor would carry out environmental monitoring, aftercare and management for the 24-month Aftercare Period following completion of the works. This would be undertaken in accordance with the agreed Preliminary Environmental Design plans.

9.12.2 During construction it will be essential to monitor the ground preparation works for all planting areas, as compacted ground severely affects the success of planting establishment.

9.12.3 During the 24-month Aftercare Period, the Contractor would review the effectiveness of the environmental mitigation against their intended function as identified within the ES and would provide any remedial actions as required.

9.12.4 Upon completion of the 24-month Aftercare Period, the management of the soft estate and environmental mitigation measures would be transferred to Highways England.

9.12.5 A high standard of landscape maintenance is required throughout the maintenance periods and monitoring will be required to ensure that this standard is maintained. Ongoing management activities and inspections during the first five years would provide the opportunity to identify any further work or measures required to deliver the required level of mitigation.

9.12.6 A Landscape Environmental Management Plan in accordance with Interim Environmental Management Plans will be produced for the Scheme, to ensure the establishment and continued growth of new plant stock and to ensure that it meets the objectives of the ES.

9.12.7 A robust and resilient palette of planting species have been selected as part of the Scheme design, however, the impacts of climate change on biosecurity and local climatic conditions will require dynamic and ongoing monitoring of the soft estate throughout its lifetime, to ensure that these valuable landscape elements remain robust and resilient.

9.13 Summary

9.13.1 In summary, the Scheme is likely to have some significant localised effects on those visual and landscape receptors immediately adjacent to the Scheme and within 500 m of the red line boundary. The wider landscape would remain largely unimpacted by the Scheme, due to the setting of the A249 within the base of a dry valley and the nature of the intervening topography and vegetation of the dip slopes, which visually contain the Scheme from the wider area. There is potential for some significant cumulative effects arising from those developments that would lead to an extension of the urban edge of Sittingbourne. Although there would be no cumulative visual effects, the combined urbanisation of the Scheme and the proposed development, specifically Land at Wises Lane (a hybrid planning application with outline permission sought for up to 595 dwellings etc. – refer to Table F.14 Volume 2 for further details), would lead to significant cumulative effects on the local/regional landscape character due to the further urbanisation of the rural landscape and coalescence with the urban edge of Sittingbourne.

9.13.2 The Scheme is of a similar nature to the existing highways infrastructure and the 7.4 m (maximum height) Stockbury flyover, although a further urbanising vertical feature within the landscape is in close proximity to the existing M2 viaduct which, from localised areas, already appears as a prominent vertical feature within this location, with the associated appearance of elevated traffic already apparent. The increase in extent of roadway and the creation of the proposed Maidstone Road Link will lead to an extension of the existing situation and exacerbate the impacts of the transport route. The loss of mature highways vegetation will feature as a significant short- to medium-term impact, but once the mitigation planting has been established by year 15, this will serve to restore the visual amenity and to an extent provide sufficient screening for a large portion of those receptors immediately adjacent to the Scheme.

9.13.3 Significant effects are largely associated with the construction and operation year 1 winter time stages (due to winter leaf loss), on a limited number of the visual receptors and landscape character areas situated within the Kent Downs AONB or located immediately adjacent to it. This is because the most visually intrusive aspects of the Scheme occur within the Kent Downs AONB (namely the Stockbury flyover, reconfiguration of the Stockbury roundabout and increased extent of associated lighting poles, widening of the A249/Oad Street) and the proposed Maidstone Road Link immediately adjacent to the M2, yet outside of the AONB. These proposed features will lead to a localised degradation of this portion of the Kent Downs AONB, however, the proposed infrastructure is in keeping with the existing urbanising features associated with the M2 and A249 and is not out of character with the current situation.

9.13.4 The visual receptors likely to experience significant effects at year 15 (residual effects) are: the residential receptors at Whipstakes Farm, located along Oad Street which would experience filtered views of the Stockbury flyover above the mitigation planting and direct views of the elevated traffic travelling along it.

9.13.5 The Scheme design seeks to reduce impacts upon the AONB through measures such as: the provision of screening planting, the use of new lighting technologies (so as to limit light pollution), the conservation of important hedgerows, the

extension of existing woodland and reconnection of fragmented woodland and landscape elements, the preservation of Ancient Woodland and veteran trees, the creation of functional ecological networks and the sensitive use of local, natural Flint stone to clad the proposed flyover and to pave the traffic islands with Kentish Ragstone setts adjacent to the Stockbury roundabout, respecting landscape character and limiting views towards the Scheme from the more typical and valued parts of the Kent Downs AONB within the surrounding area. Therefore, although a significant localised impact to the AONB is anticipated at operation year 1, the Scheme would not impact upon the wider extent of the Kent Downs AONB and design measures have been employed so as to reduce the long-term visual and landscape impacts resulting from the Scheme in its immediate context.

9.13.6 In the long-term, the Scheme will have led to the diversification of the landscape elements within the soft estate of the development, leading to an overall improvement and enhancement to the soft estate, with the strengthening, widening and bolstering of fragmented field boundaries, the reconnection of fragmented landscape elements and the increase in floristic understoreys and wildflower meadows within the estate.

9.13.7 A summary of the likely significant effects associated with the Scheme during Construction, and residual effects resulting from Operation, can be found in Table 9.23 below.

Table 9.23: Summary of likely Significant Effects

Receptor	Range of effects
Significant construction effects	
Landscape	
Regional LCA: LAK Bicknor: Mid Kent Downs.	Significant and **Moderate** Adverse landscape effects.
Regional LCA: LAK Chatham Outskirts: Mid Kent Downs.	Significant and **Moderate** Adverse landscape effects.
Local LCA: MBC: Hucking Dry Valleys	Significant and **Moderate** Adverse landscape effects.
Local LCA: SBC: Newington Arable Farmlands	Significant and **Moderate** Adverse landscape effects.
Local LCA: SBC: Tunstall Farmlands	Significant and **Moderate** Adverse landscape effects.
Visual	
Recreational receptors using the PRoW KH81 (VP 3).	Significant and **Large** Adverse visual effects.
Recreational receptor: PRoW KH85 (VP 8).	Significant and **Large** Adverse visual effects.
Outdoor employment receptors adjacent to the A249 (VP 8).	Significant and **Large** Adverse visual effects.
Recreational receptor: PRoW KH85 (VP 9).	Significant and **Large** Adverse visual effects.

Receptor	Range of effects
Outdoor employment receptors adjacent to the A249 (VP 9).	Significant and **Large** Adverse visual effects.
Recreational receptor: PRoW KH85 (VP 11).	Significant and **Large** Adverse visual effects.
Outdoor employment receptors adjacent to the A249 (VP 11).	Significant and **Large** Adverse visual effects.
Recreational receptor: PRoW ZR71 (VP 12).	Significant and **Large** Adverse visual effects.
Outdoor employment receptors adjacent to the A249 (VP 12).	Significant and **Large** Adverse visual effects.
Residential receptors adjacent to the A249 (VP 13).	Significant and **Large** Adverse visual effects.
Residential receptors: Milton Bungalow and Bowl Reed along Oad Street, in proximity to the proposed Maidstone Link Road (VP 4).	Significant and **Moderate** Adverse visual effects.
Residential receptor: Whipstakes Farm, Oad Street (VP 6).	Significant and **Moderate** Adverse visual effects.
Residential receptor at Hillside Farm (VP 15).	Significant and **Moderate** Adverse visual effects.
Recreational receptor: PRoW KH80 (VP 15).	Significant and **Moderate** Adverse visual effects.
Residential receptors adjacent to the A249: Hinecom, Sandina, Valley View Farm and White House (VP 16).	Significant and **Moderate** Adverse visual effects.
Outdoor employment receptors fronting onto the A249 (VP 16).	Significant and **Moderate** Adverse visual effects.
Residential receptors along the Maidstone Road at Danaway (VP 2).	Significant and **Moderate** Adverse visual effects.
Outdoor employment receptors adjacent to the A249 (VP 3).	Significant and **Moderate** Adverse visual effects.
Transport receptors travelling along Oad Street (VP 6).	Significant and **Moderate** Adverse visual effects.
Recreational receptors: PRoW ZR70 (VP 7).	Significant and **Moderate** Adverse visual effects.
Transport receptors travelling along the A249 (VP 13).	Significant and **Moderate** Adverse visual effects.
Residential receptors at Norton Green (VP 14).	Significant and **Moderate** Adverse visual effects.
Recreational receptor: PRoW KH80 (VP 14).	Significant and **Moderate** Adverse visual effects.
Outdoor employment receptors at Hillside Farm (VP 15).	Significant and **Moderate** Adverse visual effects.
Outdoor employment receptors adjacent to the M2 corridor (VP 10).	Significant and **Moderate** Adverse visual effects.

Receptor	Range of effects
Cumulative	
Land at Wises Lane (17/505711/HYBRID)	Significant and **Moderate** Adverse cumulative effects.
Manor Farm (17/500727/OUT)	Significant and **Moderate** Adverse cumulative effects.
Significant residual effects (operation year 15):	
Visual	
Residential receptor: Whipstakes Farm, Oad Street (VP 6).	Significant and **Moderate** Adverse visual effects.

Detailed design

9.13.8 At the Detailed Design Stage, the drainage design for the Scheme will be revised, to ensure that infiltration basins are more irregular/natural in shape and therefore to ensure that these features are better integrated into the landscape. Safety features associated with the infiltration basins, such as signage and any safety equipment will be designed to sympathetically fit/integrate within the landscape.

10. Geology and Soils

10.1 Introduction

10.1.1 This Geology and Soils chapter assesses the following topics:

- Contaminated land: effects associated with pre-existing soil and groundwater contamination (i.e. mobilising contamination, introducing new or changing existing contamination migration pathways, or changing the types of contamination receptors); and effects associated with the potential for polluting substances used during the construction or operational phases to cause new ground contamination issues on-site (for example introducing/changing the source of contamination);
- Geomorphology and ground stability: physical effects such as changes in topography, soil erosion compressible ground, aggressive ground and ground stability; and
- Agricultural land: Loss of or disturbance to agricultural soils (in particular, Best and Most Versatile (BMV) agricultural land) and farm holdings.

10.1.2 This assessment covers hydrology and hydrogeology associated with soil and groundwater contamination. Chapter 8 Road Drainage and the Water Environment assesses the potential impacts of the Scheme on the water environment as a resource and also assesses impacts associated with the potential for polluting substances to reach the water environment during operation of the Scheme.

10.1.3 For consideration of the treatment and disposal of waste soils, refer to Chapter 12 Materials and Waste.

10.1.4 Direct impacts on geology as a valuable resource i.e. mineral resource sterilisation, damage or loss of geological special protection areas such as geological sites of special scientific interest (SSSIs), were scoped out of the assessment in the Environmental Scoping Report (October 2018).

10.2 Competent expert evidence

10.2.1 This Geology and Soils chapter has been undertaken by the following individuals who have used their knowledge and professional judgement to undertake this assessment:

- Jonathan Steeds, contaminated land and hydrogeology technical director (BSc (Hons) Applied Biology, Post Graduate Diploma Hazardous Waste Management) with over 35 years' experience in contaminated land, remediation and environmental due diligence and holds professional membership with the Chartered Environmentalist, Chartered Scientist, Chartered Water and Environmental Manager, Chartered Waste Manager, Specialist in Land Condition.
- Paul Wright (BA (Hons) Geography, MSc Soil Survey and Pedology). A member of the British Society of Soil Science with over 40 years' experience of soil survey, agricultural land classification and agricultural

consultancy. Author of a number of books and scientific papers on those subjects and has worked on numerous major infrastructure projects.

- Sonja Trewavas, qualified Principal Environmental Consultant (BSc (Hons) Environmental Analysis, MSc Contaminated Land Management, CSci), with over 16 years of knowledge and experience in contaminated land and risk assessments and holds professional membership with the Institute of Environmental Science and Society of Brownfield Risk Assessment.
- Katie Bristow, Senior Hydrogeologist (BSc Geology, Post Graduate Diploma Engineering Geology, Post Graduate Diploma Hydrogeology, CGeol) with over 10 years' experience in hydrogeology, contaminated land and engineering geology and holds professional membership with the Geological Society.

10.3 Legislative and policy framework

10.3.1 Table 10.1 identifies and describes legislation, policy and guidance of relevance to the assessment of the potential geology and soil impacts associated with the Scheme.

Table 10.1: Legislation, regulatory and policy framework for geology and soils

Scale	Legislation/ regulation	Summary of requirements
National	National Planning Policy Framework (NPPF)[240]	Ground conditions: The NPPF states that local planning policies and decisions should ensure that: • The site is suitable for its proposed use, taking account of ground conditions and any risk arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation); • After remediation, as a minimum, land should not be capable of being determined as Contaminated Land as defined under Part IIA of the Environmental Protection Act (EPA) 1990 (see below); and • Adequate site investigation information, prepared by a competent person, is presented. "Decisions should contribute to and enhance the natural and local environment by protecting and enhancing…sites of... geological value and soils". "Decisions should support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land." Water Quality: The NPPF sets out policies for water quality and resources. The key aspect associated with the assessment of geology and soils assessment is "Preventing new and existing

[240] Department for Communities and Local Government (2019) Revised National Planning Policy Framework, 2019.

Scale	Legislation/ regulation	Summary of requirements
		development from contributing to, being put at unacceptable risk from, or being adversely affected by water pollution".
	National Networks National Policy Statement (NN NPS)[241]	The Government has produced a series of National Policy Statements, including the NN NPS. This provides guidance for promoters of Nationally Significant Infrastructure Projects (NSIPs). The NN NPS identifies that there is a critical need to improve the national networks to address road congestion and provide safe, expeditious and resilient networks that should be designed to minimise social and environmental impacts and improve quality of life. In delivering new schemes, opportunities to also provide environmental benefits should be considered as part of scheme proposals. The NN NPS sets out policies and provides detailed guidance in relation to the assessment of the likely main environmental issues that need to be considered for such schemes. It also details potential key mitigation measures that can be implemented to minimise any adverse effects. Paragraph 5.23 states applicants should show how a project has taken advantage of opportunities to conserve and enhance (biodiversity and) geological conservation interests. The assessment of land stability is set out in paragraphs 5.116 to 5.119. Key requirements are that the Scheme proposals must be appropriate for the location and that unacceptable risks associated with land instability are prevented. The NN NPS states that applicants should take into account the economic and other benefits of the BMV agricultural land (defined as land in Grades 1, 2 and 3a of the Agricultural Land Classification). Where significant development of agricultural land is demonstrated to be necessary, applicants should seek to use areas of poorer quality land in preference to that of a higher quality. The decision maker should give little weight to the loss of agricultural land in grades 3b, 4 and 5, except in areas (such as uplands) where particular agricultural practices may themselves contribute to the quality and character of the environment or the local economy. Applicants should also identify any effects and seek to minimise impacts on soil quality, taking into account any mitigation measures proposed. Where possible, developments should be on previously developed (brownfield) sites, provided that they are not of high environmental value. For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination and how it is proposed to address this. Guidance and policy concerning water quality are set out in detail in paragraphs 5.219 to 5.231 of the NN NPS. The objective is that new and existing development should be prevented from contributing to, or being put at unacceptable risk from, or being adversely affected by, water pollution. Key requirements are that the existing status of water quality, water resources and physical characteristics in the water environment must be ascertained and that the impacts of the proposed project, including those associated with any

[241] Department for Transport (2019) National Networks National Policy Statement (NN NPS), Accessed from https://www.gov.uk/government/collections/national-networks-national-policy-statement

Scale	Legislation/ regulation	Summary of requirements
		cumulative effects, are assessed as part of the ES. Careful design to facilitate adherence to good pollution control practice can reduce the risk of impacts on the water environment.
	Environmental Protection Act (EPA) 1990[242]	Part 2A of the EPA introduced a statutory regime for the identification and remediation of 'Contaminated Land'. It introduced, for the first time in the UK, a statutory definition of 'Contaminated Land' which is any land in such a condition that by reason of substances in, on or under the land that significant harm is being caused or there is significant possibility of such harm being caused or the pollution or significant pollution of controlled waters (all groundwater, inland waters and estuaries, excluding water perched above the zone of saturation) is being caused or there is significant possibility of such pollution being caused. Local authorities are the primary regulators under the Part 2A regime, with a duty to identify whether the land in their area is 'Contaminated Land', although provision is made for consultation and co-ordination with the Environment Agency in situations when pollution of controlled waters is an issue.
	Contaminated Land Statutory Guidance 2012[243]	The principal objectives of the relevant legislation are described in the Department for Environment, Food and Rural Affairs (DEFRA) Contaminated Land Statutory Guidance, which are to: • Identify and remove unacceptable risks to human health and the environment; • Seek to ensure that contaminated land is made suitable for its current use; and • Ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development. These objectives underlie the 'suitable for use' approach to the assessment and remediation of 'land contamination'. This approach recognises that the risks presented by any given level of land contamination will vary greatly according to the use of the land and a wide range of other factors, such as the sensitivity of the underlying geology and the receptors which may be affected. The 'suitable for use' approach consists of three elements: • Ensuring that land is suitable for its current use; • Ensuring that land is made suitable for any new use; and • Limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land.

[242] United Kingdom Parliament (1990) Environmental Protection Act, Accessed from https://www.legislation.gov.uk/ukpga/1990/43/contents
[243] Department for Environment, Food and Rural Affairs (2012) Environmental Protection Act: Part 2A Contaminated Land Statutory Guidance, Accessed from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/223705/pb13735cont-land-guidance.pdf

Scale	Legislation/ regulation	Summary of requirements
	Contaminated Land Report 11 (CLR11)[244], and Guiding Principles for Land Contamination (GPLC1)[245]	These documents provide a technical framework for the identification and remediation of contamination through the application of a risk management process.
	Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66[246]	Environment Agency and National House Building Council (NHBC) Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66 provides guidance on the development and application of the consequence and probability matrix and guidance on conducting a risk assessment. R&D66 sets out land quality estimation of the Level of Risk by Comparison of Consequence and Probability.
	Water Resources Act 1991[247]	The Water Resources Act as amended sets controls of pollution of water sources in Section III. The Act contains information about water quality objectives, powers to prevent and control pollution and pollution offenses.
	Water Framework Directive (WFD) 2000[248]	The purpose of the WFD is to establish a framework for the protection of all water bodies including: Inland surface waters, transitional waters, coastal waters and groundwater. It includes directions that: • Environmental objectives should be set to ensure that good groundwater status is achieved and that its deterioration is avoided. This includes that any upward sustaining trend in the concentration of a pollutant must be identified and reversed; • A good status of groundwater requires early action and stable long-term planning of protective measures, owing to the natural time lag in its formation and renewal; and • Monitoring programmes should cover monitoring of the chemical and quantitative status of groundwater.
	Environment Agency's approach to groundwater protection[249]	The Environment Agency's approach to groundwater protection contains position statements on Source Protection Zones (SPZs), areas identified as drinking water protected areas and aquifer designations. It states that: • The development of infrastructure should be directed to less sensitive groundwater locations; • The Environment Agency will use a risk based tiered approach to regulate activities that may impact groundwater resources; and

[244] Environment Agency (2004) The Model Procedures for the Management of Land Contamination (CLR 11), Accessed from https://www.claire.co.uk/information-centre/water-and-land-library-wall/45-model-procedures/187-model-procedures
[245] Environment Agency (2010) Guiding Principles for Land Contamination, Accessed from https://www.claire.co.uk/useful-government-legislation-and-guidance-by-country/192-guiding-principles-for-land-contamination-gplc
[246] Environment Agency (2008) Guidance for the Safe Development of Housing on Land Affected by Contamination, Accessed from http://www.nhbc.co.uk/NHBCpublications/LiteratureLibrary/Technical/filedownload,33595,en.pdf
[247] UK Government (1991) The Water Resources Act (Online). Accessed from http://www.legislation.gov.uk/ukpga/1991/57/contents.
[248] European Parliament (2000) Water Framework Directive (Directive 2000/60/EC).
[249] Environment Agency (2017a) The Environment Agency's approach to groundwater protection (Online). Accessed from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/620438/LIT_7660.pdf in July 2017

Scale	Legislation/ regulation	Summary of requirements
		• The Environment Agency expects developers and operators to take into account all current and future groundwater uses and their dependent ecosystems.
Regional	Thames Basin River Basin Management Plan (RBMP)[250]	The RBMP is designed to protect and improve the quality of the water environment. It provides direction on the following topics: • Plans for the protection and improvement of the water environment; • Future plans that may affect the infrastructure sector and its obligations; • Development proposal considerations regarding the requirements of the RBMP; and • Environmental permit applications.
	Kent Minerals and Waste Local Plan 2013-2030[251]	This outlines an overarching strategy and planning polices for mineral extraction, importation and recycling and the spatial implications of economic, social and environmental change in relation to strategic minerals. Mineral Safeguarding Areas are also displayed within this plan.
	Kent and Medway Structure Plan[252]	This sets out the strategic planning framework guiding decisions by Kent County Council and Medway Council on development, transport and environmental matters between 2001 and 2021. To protect and conserve Kent's environment and resources, the plan provides policies aimed at ensuring that development does not create unacceptable levels of pollution, that development sensitive to pollution is protected and mineral resources are managed.
Local	Maidstone Borough Local Plan[253]	This sets the framework to guide the future development of the borough and: • Sets out the scale and distribution of development; • Identifies, by site, where development will be located; • Identifies where development will be constrained; and • Explains how the council and its partners will deliver the plan.
	Swale Local Plan[254]	Bearing Fruits 2031 is the adopted Local Plan for Swale. Development management policies to ensure new development is compatible with the NPPF[240] with respect to conserving and enhancing the natural environment are described in Section 7.7. Advice on the relevant local or national policies and guidance concerning pollution, land contamination, unstable land, groundwater and agricultural land is also detailed.

[250] Environment Agency (2012) Thames Water River Basin Management Plan. Updated 2015
[251] Kent County Council (2014). Kent Minerals and Waste Local Plan 2013-30, Accessed from http://consult.kent.gov.uk/portal/mwcs/mwlp-submission/proposed_mods?pointId=s1437751747421
[252] Kent County Council (2006) Kent and Medway Structure Plan, Accessed from http://www.telephonehouse.org.uk/opposite8yr/kmsp2006.pdf
[253] Maidstone Borough Council Strategic Planning (2017) Maidstone Borough Local Plan, Accessed from http://www.maidstone.gov.uk/__data/assets/pdf_file/0005/171149/Local-Plan-v2-November-2017.pdf
[254] Swale Borough Council (2017) Bearing Fruits 2031 The Swale Borough Local Plan Adopted July 2017, Accessed from https://services.swale.gov.uk/meetings/documents/s7987/FULL%20COUNCIL%2026%20JULY%20Local%20Plan%20Item%20Appdx%201%20Bearing%20Fruits%202031%20The%20Swale%20Borough%20Local%20Plan.pdf

Scale	Legislation/ regulation	Summary of requirements
		Policy DM 31 concerns proposed development on agricultural land.
	Maidstone Contaminated Land Strategy[255] and Swale Contaminated Land Strategy[256]	These strategies aim to identify and suitably deal with all land where a significant pollutant linkage exists within each borough. They set out the methods by which contamination is to be identified and the procedures by which contamination will be dealt with across the boroughs through the planning process or contaminated land legislation.

10.4 Study area

10.4.1 The Scheme boundary and an area extending 500 m from the boundary, have been considered for the geology and soils assessment and is referred to as 'the study area'. This 500 m buffer zone has been deemed suitable due to (i) the soil type surrounding the Scheme (ii) the predicted flow rate/direction within the aquifers underlying it and (iii) the proposed earthworks being generally shallow and confined to small areas. Anything beyond 500 m has not been considered as it is unlikely that impacts will occur over this distance.

10.4.2 For the purposes of the geology and soils assessment, the identified potential sources, pathways and receptors have been split into those within the Scheme boundary (on-site) and those within the wider study area outside of the Scheme (off-site).

10.4.3 For the agricultural land assessment, the study area comprises agricultural land within the Scheme boundary. Woodland is not included.

10.5 Assessment methodology

10.5.1 The assessment of the potential impacts of the Scheme on geology and soils has been undertaken over two stages.

- Stage 1 - Land contamination risk assessment and impact assessment; and
- Stage 2 – Geomorphology and ground stability and agricultural land impact assessments.

10.5.2 A previous stage of ground investigation (GI) was carried out from 19 September to 23 November 2017 for the Scheme, which was completed by Socotec[257]. Data from the previous GI and published data available for the study area have been utilised in this assessment to inform baseline conditions. Due to a change in design, a further phase of GI is currently being procured to fill gaps in the existing GI data. It is anticipated that the new data will be assessed and used to

[255] Maidstone Borough Council (2016) Contaminated Land Strategy, Accessed from http://www.maidstone.gov.uk/__data/assets/pdf_file/0020/165341/MBC-Contaminated-Land-Strategy-2016-Final.pdf
[256] Swale Borough Council (2010) Contaminated Land Strategy, Accessed from https://archive.swale.gov.uk/assets/Environmental-Protection-Team/Contaminated-Land-Strategy-2010.pdf
[257] Socotec (2018). M2 Junction 5 improvements: Factual report on Ground investigation (E7043-17)

confirm and/or update the findings and recommendations of the geology and soils assessment provided in this chapter.

Stage 1 – Land contamination risk assessment and impact assessment methodology

10.5.3 The approach adopted for the land contamination risk assessment is based on the guidance document CLR11 and the Good Practice Guide to EIA, as described in Table 10.1. These documents provide a technical framework for the application of a risk management process through the steps described below.

10.5.4 A desk study review of available information was undertaken to develop a Preliminary Conceptual Site Model (PCSM), which describes the linkages between potential contamination hazards/sources, pathways and receptors relevant to the Scheme. Where all three are present, or considered likely to be present, these are described as pollutant contaminant linkages (PCLs), which can then be subject to the risk assessment process. PCSMs have been created for the baseline, construction and operational phases of the Scheme.

10.5.5 Initial human health and controlled waters generic quantitative risk assessments (GQRAs) have been undertaken through comparison of the existing site-specific data to appropriate generic assessment criteria (GAC) in order to refine the PCSMs and evaluate each PCL and whether the concentrations of contaminants present a potential risk to receptors identified within the PCSMs.

10.5.6 Where PCLs have been identified, consideration has been given to the findings of the GQRAs and whether the PCLs could be appropriately mitigated through design and/or the development of a remediation strategy and subsequent validation. The residual risks have been determined and assessed based on estimation of consequence and probability. These will be reviewed following completion of the proposed GI.

10.5.7 The NHBC and Environment Agency report R&D66246 provides guidance on the development and application of the consequence and probability matrix (as presented in Table 10.2 below) for land contamination risk assessment.

Table 10.2: Land quality estimation of the level of risk by comparison of consequence and probability

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High likelihood**	Very high risk	High risk	Moderate risk	Moderate/ low risk
	Likely	High risk	Moderate risk	Moderate/ low risk	Low risk
	Low likelihood	Moderate risk	Moderate/ low risk	Low risk	Very low risk
	Unlikely	Moderate/ low risk	Low risk	Very low risk	Very low risk

Table Source: based on R&D66

10.5.8 The potential risk to a receptor is a function of the probability and the consequence of a PCL being realised. Probability (likelihood of an event occurring) considers both the presence of the hazard and receptor, and the integrity of the exposure pathway. Consequence considers the potential severity of the hazard and the sensitivity of the receptor. Appendix G.1 in Volume 2 includes tables which provide the definitions for classifying probability and consequence and a description of each risk rating.

Land contamination impact assessment methodology

10.5.9 The land contamination impact assessment is based on the risk assessment to assess the magnitude of impact, as described in Table 10.3 below. The significance of effect is based on the difference between the risk at baseline to that at construction and operational phases.

Table 10.3: Land contamination impact assessment (significance of effects) based on change in contamination risk

Classification of significance	Effect
Major adverse	An increase in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very low contamination risk in the baseline becomes a high or very high risk.
Moderate adverse	An increase in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk.
Minor adverse	An increase in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate/low risk.
Negligible	Negligible change in contamination risks.
Minor beneficial	A reduction in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a moderate/low contamination risk in the baseline becomes a low risk.
Moderate beneficial	A reduction in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a high contamination risk in the baseline becomes a moderate/low or low risk.
Major beneficial	A reduction in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very high contamination risk in the baseline becomes a low or very low risk.

Stage 2 – Geomorphology and ground stability and agricultural land impact assessments

Geomorphology and ground stability impact assessment methodology

10.5.10 The sensitivity of a physical feature is considered when determining consequence of an effect in the geomorphology and ground stability impact assessment. The sensitivity of each of the physical features is determined using the classifications and criteria given in Table 10.4.

Table 10.4: Criteria for classifying the sensitivity of geological and geomorphological features

Value/ sensitivity	Criteria	Examples
High	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor. Attribute has a very low capacity to accommodate the proposed change.	Buildings, including services and foundations but of high historic value or other sensitivity e.g. statutory designations, schools, residential dwellings. Ecological statutory designations with high sensitivity e.g. SSSI, LNR, SPA, Ramsar etc. Major topographic, ground stability, soil compaction or erosion hazards present at the site.
Medium	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor. Attribute has a low capacity to accommodate the proposed change.	Buildings, including services and foundations. Moderate topographic, ground stability, soil compaction or erosion hazards present at the site.
Low	Attribute only possesses characteristics which are locally significant. Attribute has some tolerance to accommodate the proposed change.	Infrastructure (roads, bridges, railways). Low topographic, ground stability, soil compaction or erosion hazards present at the site.

Table Source: Based on DMRB Volume 11, Section 2, Part 5[258]

10.5.11 Following determination of the value/sensitivity of receptors, the magnitude of construction phase and operational phase potential impacts is determined based on the criteria defined in Table 10.5.

Table 10.5: Classification of magnitude of impact

Classification of magnitude	Criteria
High	Total loss of major alterations to one of more of the key elements, features or characteristics of the baseline. The post-development situation will be fundamentally different.
Medium	Partial loss or alteration to one of more of the key elements or characteristics of the baseline. The post-development situation will be partially changed.
Low	Minor loss or alteration to one or more of the key elements, features or characteristics of the baseline. Post-development, the change will be discernible, but the underlying situation will remain similar to the baseline.
Negligible	Very minor loss or alteration to one of more of the key elements, features or characteristics of the baseline, such that post-development, the change will be barely discernible, approximating to the “no change” situation.

[258] DMRB (2008). Volume II section 2 Part 5 HA 205/08. Assessment and management of environmental effects.

10.5.12 The overall potential significance of effects is then defined using the matrix presented in Table 10.6, which describes the relationship between the value of the resource/sensitivity (as defined in Table 10.4) and magnitude of the potential impact (as defined in Table 10.5).

Table 10.6: Geomorphology and ground stability impact assessment (significance of effects)

		Magnitude of impact			
		High	**Medium**	**Low**	**Negligible**
Value/ sensitivity of environmental resource/ hazard	**High**	Major	Major / moderate	Moderate	Moderate / minor
	Medium	Major / moderate	Moderate	Moderate / minor	Minor
	Low	Moderate	Moderate / minor	Minor	Negligible

10.5.13 The significance of effect for geological and geomorphological impacts has been described in Table 10.7.

Table 10.7: Classification magnitude of impact for geomorphology and ground stability

Classification	Effect
Major adverse	Complete permanent change in topography which impacts the local community. Significant soil erosion, soil compaction or ground instability that is permanent in nature.
Moderate adverse	Partial long-term (> 10 years) change in topography which impacts the local community. Moderate soil erosion, soil compaction, or ground instability that is either permanent or long-term in nature.
Minor adverse	Limited medium-term (5 to 10 years) change in topography which impacts the local community. Limited medium-term soil erosion, soil compaction, or ground instability.
Negligible	No measurable impact on topography, soil erosion, soil compaction, or ground instability or impacts that are only temporary in nature (< 5 years).
Minor beneficial	Limited medium term (5 to 10 years) change in topography which has a positive impact on the local community. Limited medium-term reduction in existing soil erosion, soil compaction, or ground instability issues.
Moderate beneficial	Partial long-term (> 10 years) change in topography which has a positive impact on the local community. Moderate permanent or long-term reduction in existing soil erosion, soil compaction, or ground instability issues.
Major beneficial	Complete permanent change in topography which has a positive impact on the local community. Significant permanent reduction in existing soil erosion, soil compaction or ground instability issues.

10.5.14 Following the classification of magnitude, a clear statement is made as to whether the effect is 'significant' or 'not significant'. As a general rule, major and moderate effects are considered to be significant and minor and negligible effects are considered to be not significant. However, professional judgement has also been applied where appropriate.

10.5.15 The timescale (short-term or long-term) of effects are considered.

Agricultural land and soils impact assessment methodology

10.5.16 The assessment of agricultural land and soils follows the approach of the DMRB, Volume 11, Section 3, Part 6[259].

10.5.17 The significance criteria address both magnitude of impact and sensitivity of the resource and consideration of the characteristics of the impact and the receptor, namely:

- Type of impact – direct or indirect;
- Nature of impact – beneficial, adverse or negligible;
- Duration of impact – short- or long-term, reversible or not; and
- Frequency of impact – continuous or intermittent, changing with time or constant.

10.5.18 There is no nationally recognised set of criteria for assessing the impact of infrastructure schemes on agricultural land so a bespoke system has been developed to reflect the issues pertinent to this Scheme. It considers how the land is used at the baseline and the quality and versatility of the soils based on the Ministry of Agriculture Fisheries and Food (MAFF) Agricultural land classification (ALC) Grades and Natural England's Technical Information Note 049[260].

10.5.19 The following sensitivity criteria are applied to the agricultural land holdings affected by the Scheme:

- High: agricultural land which has an ALC of Best and Most Versatile (BMV) Grades 1,2 and 3a. Farm types or land-based enterprises in which the operation is dependent on the spatial relationship of land to key infrastructure, and where there is a requirement for frequent and regular access between the two, or dependent on the existence on the infrastructure itself, e.g. dairying; irrigated arable cropping and field scale horticulture; intensive livestock or horticultural production; commercial smallholdings and equestrian centres;
- Medium: agricultural land which has an ALC Grade of 3b or 4. Farm types or land-based enterprises in which there is a degree of flexibility in the normal course of operations, e.g. combinable arable crops; grazing livestock farms (other than dairying);
- Low: agricultural land which has an ALC Grade of 5. Farm types and land uses undertaken on a semi-commercial or non-commercial basis such as

[259] Department for Transport. 2001. DMRB, Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 6 Land Use – Amendment No. 1
[260] Natural England (2012). Technical Information Note TIN049: Agricultural land classification: protecting the best and most versatile agricultural land

occasional grazing by horses; and

- Negligible: agricultural land in a long-term state of disuse and reverting to scrub.

10.5.20 Magnitude of impact (change) on farm holdings is assessed using the criteria in Table 10.8 below and the magnitude of impact of the Scheme on agricultural soils (based on likely loss of BMV land) is assessed using the criteria in Table 10.9.

Table 10.8: Assessment of magnitude of impact on agricultural holdings

Magnitude	Criteria
Major	The identified impacts are predicted to result in very large damage to a farm business or rural land-based enterprise and may compromise its viability.
Moderate	The identified impacts are predicted to result in moderate or large damage to a farm business or rural land-based enterprise, but with changes to management it should remain viable.
Minor	The identified impacts are predicted to result in slight or moderate damage to a farm business or rural land-based enterprise, but with minor changes to management it should continue as before.
Negligible	The identified impacts are predicted to result in little or no damage to a farm business or rural land-based enterprise.

Table 10.9: Assessment of magnitude of impact on agricultural soils

Magnitude	Criteria
Major	The identified impacts are predicted to result in a loss of >20 ha of BMV land.
Moderate	The identified impacts are predicted to result in the loss of between 5 ha and 20 ha of BMV land.
Minor	The identified impacts are predicted to result in a loss of between 1 ha and 5 ha of BMV land.
Negligible	The identified impacts are predicted to result in the loss of <1 ha BMV land.

10.5.21 The consideration of the relationship between the sensitivity and the magnitude of impact defines the effect of the Scheme on agricultural land, as shown in Table 4.1 in Chapter 4.

10.6 Assumptions and limitations

10.6.1 It is assumed the existing M2 viaduct foundations will not be altered, however retaining walls are proposed along the A249 (crib wall and a bored pile wall). Approximate pile toe level for the bored pile wall is 55 m AOD. It is expected that piles of 25 m will be used (based on preliminary design calculations).

10.6.2 Based on the preliminary design, the following works are also assumed to be required for the development of the Scheme:

- Embankment modification or creation of new embankments;
- Other retaining structures;
- New gantries;
- Realignment of the Southern Water pipeline;
- Road widenings at grade;
- Extension of existing cuttings or new cuttings;
- Piling; and
- New drainage and soakaways.

10.6.3 The locations are shown on Figure 2.2 (6 Sheets) in Volume 3.

- Detailed design has not been finalised, however, for the purposes of this assessment, the 'reasonably likely worst-case' impact from the Scheme has been assumed and sought to be mitigated. The precautionary assumptions of the assessment include:
- Shallow ground disturbance such as stripping of topsoil/Made Ground, intrusive ground investigation works, excavation of drainage/utility conduits either temporary/permanent during the construction phase, could be anywhere within the Scheme boundary;
- The location of stockpiles from the proposed earthworks and contractor's compounds have tentatively been identified but may be subject to change;
- Where potential sources of contamination have been identified, contaminants are assumed to be present; and
- There will be areas used for storage of hazardous materials containers during the operational phase, which could be anywhere within the Scheme boundary.

10.6.4 No large-scale groundwater dewatering is expected to occur during the construction works.

10.6.5 The small amount of existing site-specific data (geo-environmental analytical data, groundwater monitoring results and groundwater analytical data) which are available for the Scheme and wider study area, is a general limitation with regards to the interpretation of the baseline conditions as there are large data gaps. All existing GI data has been used where available and, as relevant, parts of the assessment have been supplemented with desk based information.

10.6.6 Any data utilised from secondary sources are assumed to be correct and representative of site conditions.

10.7 Baseline conditions

10.7.1 This section provides a summary of the baseline geology and soil conditions of the Scheme and study area.

Current setting

10.7.2 The Scheme is mostly occupied by the M2, A249, Oad Street and Church Hill, with a varying 2-10 m buffer zone either side

10.7.3 The wider study area comprises open space/agricultural fields, farms, commercial and residential properties. Land to the south of the M2 comprises the Kent Downs Area of Outstanding Natural Beauty (AONB)[261]. Two areas of Ancient Woodland are also present in the study area (see Chapter 7 Biodiversity). A full description of the study area is provided in Chapter 2.

Topography

10.7.4 The Scheme is located within the broadly linear, northeast to southwest trending Stockbury Valley, with the A249 running partially along the valley floor and partially along the southwest facing valley flank. The M2 carriageway crosses the valley, perpendicular to the A249 via a 250 m long viaduct and connects to the A249 at Stockbury roundabout via slip roads. The Stockbury roundabout is located at approximately 65 m AOD and the M2 viaduct is at approximately 78 m AOD. The existing ground level at the bridge abutments is approximately 64 m AOD.

10.7.5 The valley sides rise to 110 m AOD on the northwest flank and 107 m AOD on the southeast flank[262].

Local history

10.7.6 The available historical maps[263] for the Scheme and study area are presented in Appendix G.2 in Volume 2. Available mapping types include historical aerial photography, Ordnance Survey Plans, 10k Raster Mapping and VectorMap Local, with scales of 1:10,000, 1:10,560 and 1:25,000 with the earliest map dated from 1870.

10.7.7 A summary of the historical maps is provided in Table 10.10. Locations of any military camps, strategic sites or security sites were either removed or replaced by fake fields or clouds between 1878 and 1981, therefore features typically associated with the presence of unexploded ordnance (UXO) are generally not available on publicly sourced aerial imagery and therefore cannot be identified.

[261] Defra (2018). Magic interactive map. Accessed from https://magic.defra.gov.uk/MagicMap.aspx
[262] Atkins (2018) Regional investment programme M2Jn5 improvement scheme Preliminary Ground Model (HE551521-ATK-EGT-XX_J1-RP-CE-000001)
[263] Landmark (2018). Envirocheck professional data sheets and historical maps package

Table 10.10: Scheme and study area history

Map	Within Scheme boundary	Wider study area (Scheme boundary – 500 m)
1870 (1:10,560)	A road is present in a northeast to southwest orientation, in the general current day location of the Old Sittingbourne Road/Maidstone Road. Green Lane is present in a west to east orientation which joins Sittingbourne Road at a T-junction in the approximate location of the present day M2. Tracks are present in the location of the present-day Church Hill, Honeycrock Hill Amels Hill and Oad Street.	The wider area is dominated by open fields and woodland, including Church Wood, Cookham Wood and Chestnut Wood. Hillside Farm and a well which is present on the property, is present adjacent to the east of Sittingbourne Road at the southern extent of the Scheme. Vale House and Woolpit Ash are located immediately south of Sittingbourne Road. Castle entrenchments are mapped approximately 150 m to the west of the Scheme, close to which is Church Farm, an old gravel pit, a church and a graveyard. A chalk pit is present 100 m to the northeast of the castle entrenchments. Two chalk quarries and kiln are present approximately 400-450 m to the north of the Scheme. Site of Cradle Oak (assumedly of historic relevance) is present 220 m to the east of Sittingbourne Road.
1894 (1:2,500)	There have been no significant changes.	There have been no significant changes.
1896 (1:2,500)	There have been no significant changes.	Vale House and Vale Cottages are present adjacent to the eastern side of the Sittingbourne Road. There have been no other significant changes.
1898 (1:10,560)	The area surrounding the Green Lane and Sittingbourne Road T-junction is named Picket Hill. Chestnut Wood is noticeably smaller with the cleared areas occupied by open fields.	The kiln and one of the chalk quarries to the north is no longer shown. The remaining quarry is now labelled ‘old chalk pit’. The chalk pit 100 m to the northeast of the castle is labelled as ‘old chalk pit’ Another chalk pit is present 180 m to the northeast of the Scheme. Woodgate House and Farm has been developed 250 m to the east of the Scheme.
1908 (1:2,500)	There have been no significant changes.	Bowl Reed is present immediately east of the Scheme. A sheep wash is present immediately east of the Scheme, close to Bowl Reed. There have been no other significant changes.
1909 (1:10,560)	There have been no significant changes.	The chalk pit 180 m to the northeast of the Scheme appears to now have a building in the centre. There have been no significant changes.

Map	Within Scheme boundary	Wider study area (Scheme boundary – 500 m)
1938 (1:10,560)	There have been no significant changes.	There have been no significant changes.
1939 – 1940 (1:10,560) 1939-1940 (1:2,500) 1940 (1:2,500)	Sittingbourne Road appears to have been reconstructed and embanked in its existing location. At the T-junction, Green Lane appears to have also been embanked.	Another building has been constructed in the centre of the former chalk pit 180 m to the northeast of the Scheme. Residential properties now occupy land either side of Sittingbourne Road at the northern extent of the study area and at the southern extent (Stockbury Valley).
1940 (1:10,560)	There have been no significant changes.	A small building is present in Chestnut Wood. There have been no significant changes. Milton Bungalow is present immediately east of the Scheme (however is not labelled as Milton Bungalow until 1967). New buildings have been constructed at Church Farm.
Aerial photography 1947 – 1949 (1:10,560)	There have been no significant changes.	The photograph reveals that the wider study area is dominated by open fields in agricultural use.
1961 (1:10,000)	There have been no significant changes.	There have been no significant changes.
1966-1969 (1:10,000 1967 (1:2,500) 1969 (1:2,500)	A road is present in a northwest to southeast orientation in the present-day configuration of the M2 which is embanked and bridges across the Sittingbourne/Maidstone Road. A footbridge is present across the new road 210 m to the west of the Scheme. On- and off-slip roads are present from Sittingbourne Road onto the new road in both directions and a roundabout is present 300 m to the south of the new road (Stockbury roundabout).	A small track present approximately between Vale Cottages and Bowl Reed bridges across the new road immediately east of the Scheme. A new development comprising seven buildings is present 200 m to the southeast of Vale House. The building within Chestnut Wood is labelled as Whipstake Farm and comprises three new buildings. A sheep wash is present close to the castle entrenchments. Gleneagles Garage is present in the northern extent of the study area and to the west of Maidstone Road. Site of Cradle Oak is no longer labelled.
1972-1974 (1:10,000)	There have been no significant changes.	The small track present between Woolpit Ash and Bowl Reed has been realigned and widened. The castle ruins are now labelled as motte and bailey. Land to the north of the Scheme is now occupied by Sittingbourne golf course and land to the northeast has seen development of residential properties. The sheep wash appears to no longer be present. New buildings have been constructed at Church Farm.

Map	Within Scheme boundary	Wider study area (Scheme boundary – 500 m)
1979 (1:10,000)	There have been no significant changes.	The former chalk pits 200 m to the northeast and 400 m to the north are no longer shown.
1980-1989 (1:10,000) 1989 (1:2,500)	There have been no significant changes.	There have been no significant changes.
1994 (1:2,500) 1995 (1:2,500)	There have been no significant changes.	The Gleneagles Garage development has been extended, with two new buildings present on the property.
1999 (1:10,000) 1999 (aerial photography)	The Sittingbourne/Maidstone Road has been widened and the existing Stockbury roundabout has been altered. A by-pass has been developed to the west of the existing Maidstone Road. The old Maidstone Road and the new by-pass converge at the Stockbury roundabout south of the M2.	Embankments are present either-side of the new by-pass. A bridge has been constructed 300 m to the north of the Scheme which connects the old Maidstone Road with Wormdale Hill.
2006 (1:10,000)	Land immediately north of the M2, on the eastern side of the Maidstone Road is occupied by tracks, suggesting construction of a new development.	A small development is present 70 m to the east of the Scheme. Two masts have been erected immediately south of the junction. Gleneagles Garage is no longer active.
2018 (1:10,000)	There have been no significant changes.	There have been no significant changes.

Unexploded ordnance

10.7.8 The regional unexploded bomb risk map for Kent (presented in Appendix G.1 in Volume 2) indicates the study area is within a low bomb risk zone. A preliminary desk study report carried out by Zetica (also presented in Appendix G.1 in Volume 2) concludes that a detailed UXO desk study is recommended for the Scheme.

Services

10.7.9 There are a number of above and below ground services present within the Scheme and wider study area. Figure 2.2 (6 Sheets) in Volume 3 displays existing utilities.

Agricultural land use

10.7.10 Four agricultural holdings will lose land to the Scheme (Figure 10.2 in Volume 3) as detailed in Table 10.11. A fifth holding, Baden Stables and Stud on Oad Street, is a commercial equestrian enterprise and is assessed in Chapter 13.

Table 10.11: Agricultural holdings affected by the Scheme

Holding	Description
E.J. Mackelden & Sons (Bobbing) Limited	1009 ha of arable land rented out through a farm business tenancy. One 3 ha grass field between Oad Street and J5 is farmed in-hand.
Thrognall Farm	69 ha fruit, vegetable and arable farm. The affected land is arable.
Grass field between A269 and Maidstone Road	3 ha grass field.
Whipstake Farm	18 ha farm under grass for horses, hay and occasional grazing by sheep. The affected field north of Oad Street is 5.27 ha.

Agricultural soils

10.7.11 There is a detailed 1:25,000 scale soil map that includes the study area[264]. This identifies two soil types within the Scheme boundary (Figure 10.2 in Volume 3) which are given a *soil series* name, as listed in Table 10.12. A series identifies soils with similar parent material, texture and other properties such as permeability and stone content that perform similarly for land use purposes.

10.7.12 Most of the affected soils are in deep deposits of chalky silty drift that blankets the lower valley slopes and valley floors. These are mapped as the Coombe/ Nettleden complex and the soils are loamy and naturally well drained.

10.7.13 On the hillside bordering Honeycrock Hill, there is the Abingdon series of shallow soils over chalk.

10.7.14 The Thanet Formation of interbedded sands, silts and clays outcrops within the Scheme boundary in Thrognall Farm adjacent to the northern link road loop of the M2. The soils are deep and loamy textured, well drained in the topsoil but often having slowly permeable subsoils. They respond well to field drainage.

10.7.15 Since the soil map was published, a 3 ha field between the A269 and Maidstone Road and land bordering the M2 between Maidstone Road and Oad Street have been used as working areas during road construction. Archaeological trenching for this project identified extensive areas of up to 2.0 m of Made Ground[265]. It has been returned to farming but it is primarily suited to permanent grass rather than arable.

Table 10.12: Agricultural soils affected by the Scheme and their ALC grade

Soil series	Parent material	Description	ALC grade
Abingdon	Chalk	Well drained loamy soils over chalk at shallow depth. Gradients <7 degrees.	3a
Coombe/Nettleden complex	Head and colluvium	Deep well drained soils in chalky silty drift on valley bottoms.	2

[264] Fordham SJ and Green RD (1976). Soils in Kent III. Sheet TQ 86 (Rainham). Harpenden
[265] Oxford Archaeology South (2018). M2 Junction 5 Improvements, Kent. Archaeological Evaluation Report (for Hochtief UK Construction Ltd)

Soil series	Parent material	Description	ALC grade
Bursledon	Thanet Formation sands, silts and clays	Deep loamy soils with slowly permeable subsoils that respond well to field drainage.	2
Made-ground (originally Coombe/Nettleden complex)	Disturbed soils in Head and colluvium	Variable soils in up to 2 m of made-ground lacking topsoil in places.	4

Agricultural land classification

10.7.16 The land affected by the Scheme is all shown as Grade 3 (good to moderate quality) on the chalk hillsides and Grade 2 (very good quality) on the lower ground (Figure 10.2 in Volume 3). The published MAFF 1:250,000 Provisional ALC Map[266] provides only a broad indication of land quality and should not be used definitively on specific sites smaller than 80 ha in size.

10.7.17 There are no available recent or detailed ALC surveys of the study area. However, it is possible to apply MAFF's 1988 Revised Guidelines taking into account climatic, site and soil conditions.

10.7.18 The shallow Abingdon series over chalk on a gradient of less than seven degrees is in Subgrade 3a (moderate quality).

10.7.19 The Coombe/Nettleden complex and Bursledon series are deep, well drained loams with good reserves of soil moisture over the growing season and are in Grade 2 (very good quality).

10.7.20 This confirms the Grade 2 classification of the lower ground on the Provisional ALC map and the Grade 3 of the chalk hills.

10.7.21 The Made Ground adjacent to the A296 and M2 is assessed as Grade 3b because of the irregularity of the soil profiles that creates patchy crop yields.

10.7.22 The ALC grades of land within the Scheme boundary is shown on Figure 10.1 below.

[266] Natural England (2010). London & South East Region 1:250 000 Series Agricultural Land Classification, Map Reference 10-111g (ALC007), retrieved 15 October 2018 from: http://publications.naturalengland.org.uk/publication/141047?category=5954148537204736

Figure 10.1: Detail from the provisional agriculture land classification map (2010)

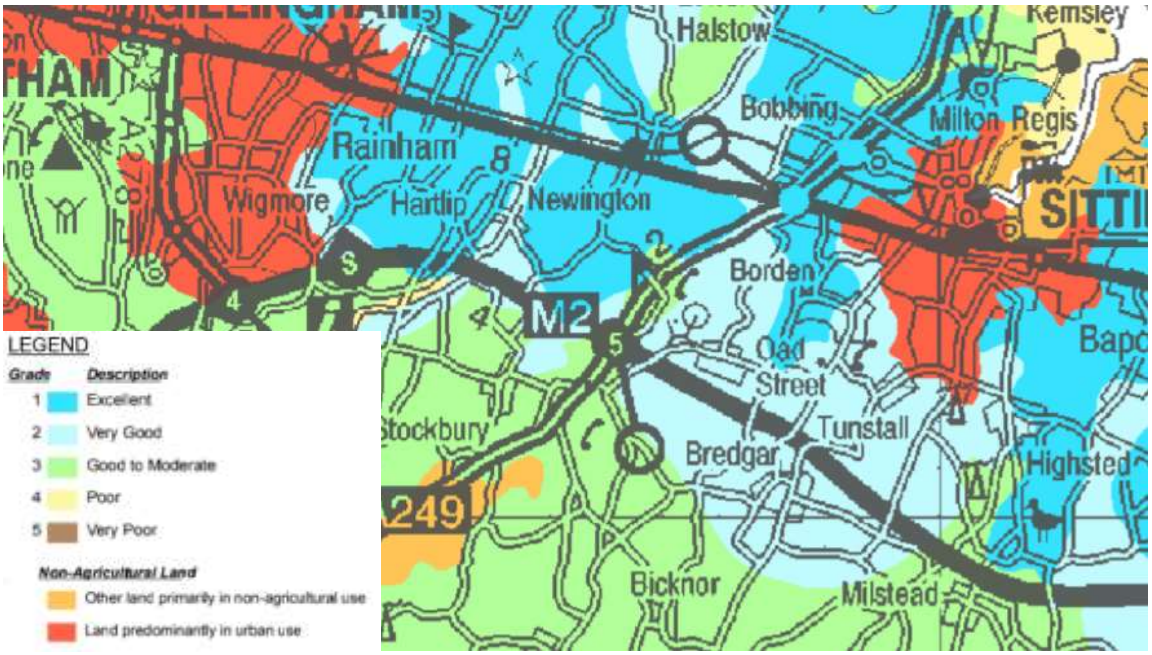


Figure Source: Natural England (2010). London & South East Region 1:250 000 Series Agricultural Land Classification, Map Reference 10-111g (ALC007)

Geology

10.7.23 The geological conditions beneath the Scheme and study area are summarised below. The thicknesses of the strata encountered and the material descriptions are presented in Table 10.13. For area-specific strata encountered in the recent GI carried out by Socotec[257], refer to the Preliminary Ground Model report[262] which presents the strata and depths beneath specific sections of the Scheme as the variability across the Scheme is high.

Artificial ground

10.7.24 Made Ground has been encountered in various locations throughout the study area during the recent GI[257] and is expected to be present beneath foundations of existing developments, including the M2 and A249. Infilling of depressions, ponds, old pits and quarries is also likely to have occurred (see Section 10.7.54 for details).

10.7.25 Some embankments associated with the roads were formed from materials generated from cuttings made during previous phases of earthworks[267].

10.7.26 The study area is within the zone of influence of the Chatham Land Front World War I Defences and is known to have contained crenelated trenches which were infilled in 1919. These infilled features typically trend southwest to northeast and are present across the study area, intersecting the boundary of the Scheme[268].

[267] HAGDMS 2049: Kent County Council (1973) A249 Improvement M2 to Bobbing Railwfigure ay Bridge Soil Survey Report
[268] WSP (2018). Preliminary Sources Study Report

Superficial deposits

10.7.27 It is illustrated on the British Geology Survey (BGS) Geology of Britain viewer[269] that the Stockbury roundabout, part of the slip roads and the section of the A249 within the study area are underlain by head deposits, likely associated with a stream once present in the Stockbury Valley. There are also localised head deposits expected to the north-western and south-eastern extents of the study area. Where the deposits are relatively thick, they are divided into upper cohesive deposits and lower, more granular material.

10.7.28 The land to the east and west of the Stockbury roundabout is expected to be underlain by Clay-with-Flints Formation[269]. Clay-with-Flints were, however, not encountered in the recent GI[257].

Bedrock geology

10.7.29 Localised Thanet Formation is likely to be present beneath the Scheme, specifically beneath the east-bound off-slip and the west-bound on- and off-slips[263].

10.7.30 The White Chalk Subgroup (Seaford Chalk Formation) underlies the entirety of the Scheme and study area[269]. The recent GI carried out by Socotec indicated that the top of the chalk is structureless[257].

10.7.31 Lewes Nodular Chalk formation is expected to be present beneath the Seaford Chalk Formation[257].

Table 10.13: Summary of geology beneath the study area[257,262,269]

Stratum	Description	Average thickness	Depths present from/to
Topsoil	N/A	0.40 m	0.00-0.50 m bgl
Artificial ground	Typically comprising either: (i) white and yellowish or brownish white remoulded chalk or fine to medium size chalk gravel or light brown clayey remoulded chalk matrix with occasional coarse sand-sized brick fragments; or (ii) firm brown or orangish brown sandy silty clay with occasional flint and chalk gravel.	3.43 m	0.00-4.00 m bgl
Cohesive Head	Typically described as soft to firm, locally stiff orangish brown sandy gravelly clay with rare chalk and flint fragments.	2.28 m	0.40-6.50 m bgl
Granular Head	Typically described as clayey or silty fine to course gravelly sand.	2.18 m	0.30-9.00 m bgl
Clay-with-flints	Typically described as orange-brown and red-brown sandy clay with abundant nodules and rounded pebbles of flint.	0.9 m (only present within area of New Maidstone Road Link)	0.30-1.20 m bgl (only present within area of New Maidstone Road Link)

[269] BGS (2018) Geology of Britain Viewer. Available from http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Stratum	Description	Average thickness	Depths present from/to
Thanet Formation Sand	Typically described as clayey and glauconitic. The sand interbedded with silts and clays can also include flints and more rarely calcareous or siliceous sandstones.	8.50 m up to 13 m in the north of the Scheme	0.50-9.00 m bgl
White Chalk Subgroup (Seaford Chalk Formation)	Structureless: (i) White and cream with rare orange staining, silty sandy chalk gravel with low cobble (flint) content; or (ii) a gravelly cream silt.	Understood to be between 175 and 200 m in total, with structureless chalk averaging 3.00 m.	5.00-11.5 m bgl (M2 J5 Slip Road cut slope expected shallower at 0.5 m bgl and at New Maidstone Road Link at ~2 m bgl)
	Structured: (i) Cream occasionally stained orangish brown chalk with occasional coarse gravel and cobbles of flint. Occasional very thin and thin beds of flint have also been observed; or (ii) cream frequently to occasionally stained light brown chalk with rare cobbles of flint.		9.0-11.5 m bgl (M2 J5 Slip Road cut slope expected shallower at ~2.5 m bgl)
Lewes Nodular Chalk Formation	Hard to very hard nodular chalks and hardgrounds with interbedded soft to medium hard chalks (some grainy) and marls with some griotte chalks. The softer chalks become less abundant towards the bottom. Nodular chalks are typically lumpy and iron-stained (usually marking sponges). Brash is rough and flaggy or rubbly and tends to be dirty. First regular seams of nodular flint, some large, commence near the base and continue throughout.	Not proven	Not proven

Mining activity and quarrying

10.7.32 The BGS and National Geoscience Information Service suggest the Scheme and study area are unlikely to have been mined for coal[263].

10.7.33 All known pits, quarries and deneholes within the study area[263] (including those identified on historical maps) have been summarised in Table 10.14 below.

Table 10.14: Summary of pits/quarries and deneholes within the study area

Name/type	Location
Former Vale House Chalk Pit (open cast)	Honeycrock Hill; 100 m to the west of the Scheme.
Former Danaway Chalk Pit	Along Maidstone Road; 147 m to the northeast of the Scheme.
Church Farm Gravel Pit	Church Farm, 200 m to the west of Scheme.

Name/type	Location
Former Danaway Chalk Pit	Woodgate Lane, 206 m to the northeast of Scheme.
Former Danaway Chalk Pit	Maidstone Road; 340 m to the northeast of the Scheme.
Wormdale Hill sand and gravel Pit	Wormdale Hill, 250 m of the Scheme.
Possible Denehole	West-bound off-slip, within Scheme boundary.
Chalkwell	25 m to the south of Oad Street, within Scheme boundary.
Solution pipe x6	35 m to the east of the old Maidstone Road.

10.7.34 There is a moderate possibility that unrecorded cavities exist within the study area.

Ground stability hazards

10.7.35 The BGS and National Geoscience Information Service suggest that there is a very low hazard potential from collapsible ground and no hazard potential for compressible ground within the Scheme[263].

10.7.36 There is deemed a high hazard potential from ground dissolution within the Scheme (dependant on the proximity of chalk to the surface as some areas within the Scheme are deemed to have a moderate to very low hazard potential for ground dissolution)[263].

10.7.37 There is generally a low hazard potential arising from landslides within the Scheme or study area, with localised areas deemed to have a moderate hazard potential from landslides. These are associated with the embankment on the southern side of the viaduct between the old Maidstone Road; the west-bound on-slip and east of the old Maidstone Road, to the north of the M2 and east of the A249 at Crookham Shaw, and land between Honeycrock Hill and Amels Hill roads, to the west of A249 and south of the Stockbury roundabout[263].

10.7.38 There is generally a very low hazard potential from running sands. There are a number of areas for which running sand has been assessed as having a moderate hazard potential, which are 50 m to the south of the west-bound off-slip, 100 m to the south of the M2 (opposite the eastbound on-slip), and 240 m to the west of Stockbury roundabout[263].

10.7.39 The north-eastern section of M2 Junction 5 was characterised as having a very high Subsidence hazard[270]. Previous remedial works carried out in 2006 included compaction grouting within a depression between the London bound off-slip carriageway along with the repair of a broken drain[271]. Broken drains may be a

[270] InterRoute (2005). M2 Junction 5 Geotechnical Report (HAGDMS 20489)
[271] InterRoute (2006). M2 Junction 5 Phase II Geotechnical Report (HADMS 21190)

potential trigger for the formation of the solution feature through aggravating erosion268,[272].

10.7.40 No faults are expected within the Scheme or study area[262].

Chemical attack on concrete

10.7.41 Made Ground and some natural ground may have elevated concentrations of pyrite, sulphate and sulphides which can have detrimental impacts on concrete structures[273].

Groundwater

10.7.42 The Environment Agency and BGS aquifer designations for superficial deposits and bedrock formations are presented in Table 10.15.

Table 10.15: Aquifer designations

Unit	BGS designation	Environment Agency designation
Artificial ground	-	No designation / Unproductive
Head	Variable	Secondary (undifferentiated) - Superficial
Clay-with-Flints	Rock with essentially no groundwater	No designation/Unproductive Strata
Thanet Formation Sand	Variable	Secondary 'A' - Bedrock
White Chalk Subgroup (Seaford Chalk Formation)	Highly productive	Principal - Bedrock
Lewes Nodular Chalk Formation	Highly productive	Principal - Bedrock
Notes: Principal aquifer (bedrock): "these are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer". Secondary A aquifer (superficial and bedrock): "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These were formerly classified as minor aquifers". Secondary (undifferentiated) aquifer: "has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type". Unproductive Strata: "geological strata with low permeability that have negligible significance for water supply or river base flow".		

[272] WSP (1999). Area 4 Term Maintenance M2 Junction 5 Investigation and Repair Geotechnical Report
[273] BFS (2017) Sulphates and sulphides. Available from https://www.bgs.ac.uk/research/environmentalModelling/GeoProperties/SulphatesSulphides.html

10.7.43 Borehole log (TQ86SE34) available on BGS viewer suggests the groundwater rest level to be at 32.5 m AOD[274], located to the eastern side of the A249, approximately 390 m to the southwest of the Stockbury roundabout.

10.7.44 Groundwater levels are monitored by Atkins at a groundwater monitoring point in Danaway (at the northern extent of the study area). Abstraction in the vicinity has influenced the groundwater levels recorded. Since 2002 the water table has, on occasion, dropped to levels of -15 m AOD to -20 m AOD. In May 2017, the groundwater level peaked over the 16-year monitoring period at 14 m AOD.

10.7.45 A previous investigation carried out in the vicinity of the Stockbury viaduct bearing replacement works[275], proposed the groundwater level within the Chalk to be in excess of 25 m bgl at the base of the dry valley (approximately 35 m AOD). However, one of the three boreholes associated with this previous GI encountered saturated shallow soils and standing water at 14 m bgl (approximately 46 m AOD). This borehole was deemed an exception, as it was located in an area subject to uncontrolled discharge of surface water and the surface is known to pond during rainfall events[275], therefore it is considered to be localised and not likely to be representative of the water table.

10.7.46 The maximum groundwater levels recorded in the last 10 years from Environment Agency observation boreholes and Southern Water abstraction boreholes (between 1 km and 4 km from the Scheme) is approximately 30 m AOD.

10.7.47 Given the information available, groundwater could be present anywhere between 14 m AOD and 32.5 m AOD, however the 14 m AOD measurement is affected by abstraction and more likely the natural water table would be between 25 m AOD and 32.5 m AOD.

Groundwater abstraction

10.7.48 There are two active groundwater abstraction licences within the study area, for further details refer to Chapter 8 Road Drainage and the Water Environment.

Source Protection Zones

10.7.49 Given the nearby groundwater abstractions described above, the Scheme and study area are partially underlain by groundwater SPZs[276]. The northern extent of the Scheme (A249) falls within an inner zone I SPZ[277]. The central area of the Scheme falls within an outer zone II SPZ[277] and the southern extent of the

[274] BGS (2018). Geology of Britain Viewer. http://scans.bgs.ac.uk/sobi_scans/boreholes/758698/images/14971909.html
[275] Southern Testing (2017). Combined Preliminary Sources Study Report, Ground Investigation Report and Geotechnical Design Report (Ref. J13307 PSSR/GIR/GDR Ver.003
[276]. Environment Agency (2018) Groundwater Source Protection Zones. Available from http://apps.environment-agency.gov.uk/wiyby/37833.aspx
[277] Groundwater SPZs are defined and designated by the Environment Agency. These zones show the risk of contamination from any activities that might cause pollution in the area. There are three main zones (inner, outer and total catchment). **Inner zone (Zone 1)** - Defined as the 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres. **Outer zone (Zone 2)** - Defined by a 400 day travel time from a point below the water table. The previous methodology gave an option to define SPZ2 as the minimum recharge area required to support 25 per cent of the protected yield. This option is no longer available in defining new SPZs and instead this zone has a minimum radius of 250 or 500 metres around the source, depending on the size of the abstraction. **Total catchment (Zone 3)** - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. There is still the need to define individual source protection areas to assist operators in catchment management

Scheme is not within an SPZ. A section of the Stockbury roundabout falls within an outer zone III SPZ[277].

Groundwater Vulnerability Zones

10.7.50 Based on Sheet 40 of the Thames Estuary groundwater vulnerability map, the soil within the Scheme boundary is deemed as having intermediate to high leaching potential[263].

Surface water

10.7.51 There are no significant surface water features within the Scheme or study area. One small pond is present within a private property approximately 200 m to the south of the Stockbury roundabout and another small pond is present just to the east of the private property. The pond within the private property is not visible on aerial photography captured in 1940[278], however the small pond is visible as an area with artificial sidings from 1967[263]. A field drain, which runs alongside Oad Street, is present between the M2 and Milton Bungalow. All of these features are believed to be associated with highway drainage.

10.7.52 A more detailed summary of surface water features in the study area is provided in Chapter 8 Road Drainage and the Water Environment.

Landfill and waste management sites

10.7.53 No known historical landfill sites or active licensed landfill sites and no waste management facilities are present within the Scheme or study area.

Potentially infilled land

10.7.54 Cavities such as quarries and pits have the potential to have been infilled with unknown material. Therefore, the features listed in Table 10.14 are included within the assessment as being possible sources of contamination due to the infill material being of unknown provenance. The sheep washes identified on historical maps were potentially infilled. No other water-features were identified on historical maps within the study area which may have been infilled.

10.7.55 World War I trenches, which were once present in the study area are known to have been infilled in 1919[268].

Potentially contaminative land uses

10.7.56 Google Maps[279] and the Envirocheck report[263] have been utilised to identify historical and active industrial land uses within the study area. These include:

- Inactive Gleneagles Garage (90 m to the east of the northern extent of the Scheme);
- Glass producers 100 m to the east of the Scheme (along the old Maidstone Road);
- Inactive Shell garage 150 m to the east of the Scheme (along the old

[278] Google Earth Pro (2018) Sittingbourne, Kent
[279] Google (2018) Google Maps. Available: https://www.google.co.uk/maps/@51.3283531,0.6628474,16.08z

Maidstone Road);

- Former slate producers 200 m to the west of the Scheme (Church Farm);
- Waste processing machinery suppliers 200 m to the west of the Scheme (Church Farm);
- Agricultural machinery sales and servicing 200 m to the west of the Scheme (Church Farm);
- Vehicle repair/MOT centre 200 m to the west of the Scheme (Church Farm);
- Former sheep washes (Bowl Reed and close to Church Farm);
- A tank located at Woodgate Farm 250 m to the northeast of the Scheme, a tank located 220 m to the west of the Scheme (Church Farm), and one located within a field 450 m to the west of the Scheme;
- Waste storage, processing and disposal facility along Woodgate Lane; and
- Former builder's merchants 500 m to the northeast of the Scheme (along Woodgate Lane).

10.7.57 The inactive Gleneagles Garage is expected to have underground fuel tanks left in-situ, which are thought to have been infilled with water[280]. The site is currently occupied by vehicles and what appear to be shipping containers[279]. No GI is known to have been carried out and the structures remain on the property.

10.7.58 Aerial photography suggests land 70 m to the east of the south-eastern boundary of the Scheme appears to have been established for waste storage, also with evidence of an area utilised for bonfires. Another similar land use is present immediately east of the pond, 200 m to the south of Stockbury roundabout.

10.7.59 Land directly beneath the M2 viaduct and located between the A249 and the Old Maidstone Road has been cleared of vegetation[279]. This is currently used as a compound for works currently being carried out on the viaduct.

Pollution incidents

10.7.60 There has been one recorded pollution incident within the study area. This occurred in 1998 and was considered a minor incident to controlled waters resulting from autoclave liquid leaking into a gully 80 m to the south of Oad Street bridge[263]. Given this was a minor incident and occurred 20 years ago, it is unlikely to be of importance to the contaminated land assessment.

Previous ground investigation

10.7.61 Descriptions of Made Ground during the recent GI257 indicate limited evidence of visual or olfactory signs of contamination. Logs which noted evidence of potential contamination are summarised in Table 10.16.

[280] R. Carr Geotechnical Services (2008). Geo-environmental Desk Study and Qualitative Risk Assessment for proposed redevelopment of former Gleneagle Petrol Station (Ref. RC/AF/2377/08). Available: https://pa.midkent.gov.uk/online-applications/files/E0B8031DD1D985FE8EB49C92FA90AB91/pdf/17_501259_OUT-Geo_Environmental_Desk_Study-4063705.pdf

Table 10.16: Evidence of potential contamination noted on exploratory hole logs

Exploratory hole	Depth (m bgl)	Description
BHCP04	0.0-1.90	Firm orangish-brown slightly gravelly sandy clay. Gravel is sub-angular to sub-rounded fine to coarse of flint and rare ash.
TP24	0.0-0.35	Made Ground: Soft greyish brown very sandy clay with rare angular to sub-angular fine to medium fine, chalk, clinker and ceramic fragments.
TP25 P1RC	0.0-0.50	Made Ground: Reworked topsoil with 0.10 m long piece of pink rope.
TP07	0.0-0.30	Plastic sheeting.

10.7.62 In January 2018 trial pits were dug within the vicinity of the proposed link road for the purpose of archaeological investigation. Buried asbestos containing material was identified in one of the archaeological trenches[281] (located within the vicinity of the proposed link road). No remediation was carried out and the extent of the buried asbestos containing material is not known.

10.7.63 During the Socotec GI[257], 92 soil samples were collected from 60 exploratory hole locations and analysed for metals/metalloids, organics, polycyclic aromatic hydrocarbons (PAHs), aliphatic and aromatic Total Petroleum Hydrocarbons (TPH) and asbestos.

10.7.64 Detailed guidance on human health risk assessment is available in Science Report 2 (SR2)[282], SR3[283] and the CLEA Model[284].

10.7.65 Soil Organic Matter (SOM) consists of plant and animal remains in varying stages of decomposition. The presence of SOM is important in determining the fate and behaviour of a number of organic contaminants such as PAHs and chlorinated solvents. The mobility of these contaminants decreases with increasing SOM. SOM was analysed in 33 soil samples and varied between 0.24% and 6.58%. Therefore, as a precautionary approach, the lowest SOM content was assumed for all soil samples collected.

10.7.66 Soil data have been compared with GAC (as mentioned in 10.5.5) which comprise:

- Atkins Soil Screening Values (SSVs): derived using the CLEA Model for sandy soil with 1 % Soil Organic Matter (SOM) for public open space; and
- Category 4 Screening Values (C4SLs) (benzo(a)pyrene, benzene, lead, arsenic, cadmium and chromium) by DEFRA[285]. C4SLs are low risk levels which are not representative of significant possibility of significant harm and

[281] Oxford Archaeology (2018). M2 Junction 5 Improvements, Kent. Archaeological Evaluation Report. Ref. 6821
[282] Environment Agency (2009). Human Health Toxicological Assessment of Contaminants in Soil. Science Report SC050021/SR2
[283] Environment Agency (2009). Updated Technical Background to the CLEA Model. Science Report SC050021/SR3
[284] Environment Agency (2009). CLEA Software (Version 1.05) Handbook. SC050021/SR4.
[285] Defra (2013). Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Ref: SP1010

as such, if the C4SLs are not exceeded, land can be demonstrated as being in Category 4 and cannot be determined as contaminated land.

10.7.67 There were no exceedances of GAC within the 92 soil samples. However, asbestos was detected in four of the 92 soil samples which were screened for the presence of asbestos, collected from BHCP10 (0.2 m bgl), BHRC14 (0.15 m and 0.5 m bgl) and BHCP09 (0.2 m bgl). These exploratory holes were all within 100 m of Oad Street, to the south of the M2 and to the east of the A249 and are considered to be within proximity to each other. The samples were not analysed for asbestos fibre type.

10.7.68 Groundwater was not present during the monitoring of the groundwater wells during the recent GI, therefore no groundwater analytical data are present for the Scheme.

Summary of potential sources of contamination

10.7.69 Sources of potential contamination identified within the study area are summarised below and shown on Figure 10.1 in Volume 3:

- On-site and off-site areas of Made Ground or infilled ground of unknown physical and chemical quality (pits, quarries, WWI trenches, road construction/embankments, infilled sheep washes);
- On-site vehicle emissions, spills and leaks from the long-term use of the A249 and M2;
- Off-site historical quarrying activities (including kiln);
- Off-site farming activities (including two sheep washes);
- Off-site inactive service stations (Gleneagles Garage and Shell Garage);
- Commercial and light industrial land uses along Church Lane, at a property formerly known as Church Farm (machinery suppliers, agricultural machinery servicing, slate producers and a vehicle repairs/MOT centre) and along the old Maidstone Road (glass producers);
- Off-site tanks;
- Off-site former builder's merchants; and
- Off-site unclassified waste storage/burning on private properties.

10.7.70 Although the existing GI data suggest that the risk to human health receptors is low, as there are no exceedances of the GAC other than the presence of buried asbestos, the data gaps and the sources listed above indicate the overall risk remains unknown.

Potential receptors

10.7.71 Potential contamination receptors have been categorised as relating to human health, controlled waters, ecology and property and these are shown on Figure 10.1 in Volume 3.

10.7.72 Potential human health receptors include:

- On-site construction workers and site workers;
- On-site and off-site members of the public using public rights of way;
- Off-site residents; and
- Off-site workers and visitors at commercial/industrial premises and recreational facilities.

10.7.73 It is considered that exposure to potential sources of contamination for members of the public using the highways will be of limited frequency and duration. As such, they have not been considered further as receptors in identified PCLs.

10.7.74 Risks to workers are also expected to be managed by their employers, with the use of appropriate working methods and Personal Protective Equipment (PPE) as required by the Health and Safety Executive[286].

10.7.75 Potential controlled waters receptors include:

- Groundwater within the bedrock Principal aquifer and bedrock and Superficial Secondary A aquifers and groundwater abstractions and SPZs (I, II and III) within the Scheme extent and study area.

10.7.76 Potential property receptors include:

- Piles and other foundations in the proposed works areas;
- Underground services (within Scheme extent); and
- Property (including residential, commercial, farming and light industrial).

10.7.77 Potential ecological receptors include:

- Off-site areas of Ancient Woodland.

Potential pathways

10.7.78 Subject to the findings of the proposed GI, plausible exposure pathways of contamination to human health receptors may include but are not limited to:

- Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres;
- Inhalation, ingestion and dermal contact with contaminated perched groundwater (if present);
- Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion; and
- Inhalation of vapours.

10.7.79 Subject to the findings of the proposed GI, plausible exposure pathways of contamination to controlled water receptors may include, but are not limited to:

- Leaching/vertical migration of contaminants in soils to underlying groundwater;
- Lateral/vertical migration of contaminants in groundwater or to deeper

[286] Health and Safety Executive (1992). Personal Protective Equipment at Work Regulations.

groundwater; and

- Migration of contamination entrained in surface water run-off.

10.7.80 Subject to the findings of the proposed GI, plausible exposure pathways of contamination to property receptors may include, but are not limited to:

- Chemical attack from direct contact of aggressive chemical constituents in soil or perched groundwater if present; and
- Migration of ground gases or vapours along preferential pathways including permeable ground, services trenches and service entry points and accumulation in enclosed spaces such as services ducts or access points, followed by ignition causing an explosion.

10.7.81 Subject to the findings of the proposed GI, plausible exposure pathways of contamination to ecological receptors may include, but are not limited to:

- Migration of contaminants entrained in surface water run-off.

Future baseline

10.7.82 The potential for the soils and geology baseline to change prior to construction and operation is limited to changes in land use within the study area and any future pollution incidents that may occur within the study area.

10.7.83 Pollution incidents in the study area are infrequent (one reported in the last 20 years) the future baseline is therefore unlikely to change prior to construction or operation through pollution.

10.7.84 Proposed developments that have been identified within the geology and soils study area that could change the land use include:

- Land at Woodgate Lane (Ref. 15/507804/FUL); and
- Builder's Yard (18/505147/PNP).

10.7.85 Both developments are related to a change in use from builders yards to residential dwellings. In order for the land to be fit for use for residential dwellings, remediation may be required which may improve the baseline prior to construction of the Scheme. However, this is not likely to materially alter the baseline conditions assessed.

10.8 Potential impacts

10.8.1 The Scheme has the potential to impact the receptors listed above. A summary of the potential impacts has been presented below in three sections: impacts associated with land contamination, those associated with geomorphology and ground stability, and those associated with agricultural land.

Land contamination potential impacts

10.8.2 The construction phase could potentially introduce new sources of contamination and may also introduce new pathways for migration of existing contamination. The following construction phase activities may contribute to the creation of new PCLs:

- Potential disturbance and mobilisation of contamination present within the ground;
- Creation of confined spaces, such as manholes and service chambers/ducts, within which ground gas has the potential to accumulate;
- Piling or excavation during construction could create new pathways between any contaminated soils and the underlying groundwater;
- Potential for increased run-off during earthworks with a high sediment (contamination) load; and
- Any dewatering activities (although none are expected based on existing baseline conditions) have the potential to mobilise contaminated groundwater and enhance lateral migration of contamination within the superficial and bedrock aquifers.

10.8.3 If no mitigation measures are implemented, risks to the identified receptors are deemed high/moderate and impacts are likely. However, with the implementation of mitigation measures through design and standard construction practices, risks to the identified receptors can be reduced.

10.8.4 During the operational phase, it is anticipated that no new PCLs are likely to be created. However, incidents have the potential to introduce new sources of contamination. The Outline Environmental Management Plan (OEMP) for the Scheme will address how these incidents will be managed and detail the emergency management procedures to be implemented in such an event. Further details are provided in Chapter 8 of this Environmental Statement. With mitigation measures incorporated, no impact is anticipated during the operational phase.

10.8.5 The full land contamination risk assessment is presented in Appendix G.1 in Volume 2.

Geomorphology and ground stability potential impacts

10.8.6 The Scheme could potentially impact geomorphology and ground stability across the study area and will impact the topography within the Scheme boundary. Moderate hazards are shown on Figure 10.1 in Volume 3. Topography is discussed in detail in Chapter 9 Landscape and Visual.

10.8.7 Construction activities and land clearance have the potential to increase soil erosion and degrade soil quality. The Scheme could also impact the ground in areas where geological stability hazards have been identified.

10.8.8 Potential impacts during the operational phase include changes to physical properties and ground instability.

Agricultural land potential impacts

10.8.9 During the construction phase, approximately 11.7 ha will be taken from four agricultural holdings. Most, if not all, land within the Scheme boundary will be permanently acquired for the engineering footprint of the Scheme and planting and ecological mitigation.

10.8.10 The site compound will potentially be located under the M2 viaduct (land which is already used as a compound).

10.8.11 Eighty eight percent of the agricultural land taken from the four holdings is of BMV quality.

10.8.12 Dust may affect crops close to the construction boundary during construction. This will generally be of little consequence, except on Thrognall Farm where fruit trees are within 25 m of the construction zone.

10.8.13 Most of the affected land is in arable use so noise will not affect livestock, apart from Whipstake Farm which keeps horses and sheep.

10.8.14 No land will be severed or otherwise rendered inaccessible.

10.8.15 Potential impacts on agricultural holdings are summarised in Table 10.17.

Table 10.17: Potential impacts on agricultural holdings (construction)

Holding	Area (ha)	Area of acquisition within Scheme boundary (ha) and % of holding	Other impacts	ALC Grade of perm. loss (ha)
E.J. Mackelden & Sons (Bobbing) Limited	1012	7.8 (0.8%)	Dust affecting neighbouring crops	Grade 2 – 5.3 ha Grade 3a – 2.0 ha (both BMV) Grade 3b – 0.5 ha
Thrognall Farm	69	1.8 (2.6%)	Dust affecting neighbouring crops	Grade 2 – 1.8 ha (BMV)
Grass field between A269 and Maidstone Road	3	0.9 (30%)	Dust affecting neighbouring crops	Grade 3b – 0.9 ha
Whipstake Farm	18	1.2 (6.7%)	Dust affecting neighbouring crops Noise affecting horses and sheep	Grade 2 – 1.2 ha (BMV)

10.8.16 Total loss of land by ALC grade is summarised in Table 10.18.

Table 10.18: Loss of land by ALC grade

ALC grade	Area (ha)	As % of total
2 (BMV)	8.3	71%
3a (BMV)	2.0	17%
3b	1.4	12%

10.9 Design, mitigation and enhancement measures

Design measures

10.9.1 The proposed GI will be carried out to inform the design and to confirm and define the appropriate mitigation measures listed below.

10.9.2 The data gathered from the proposed GI will inform the Materials Management Plan (MMP) and Site Waste Management Plan (SWMP) (if required). Further information is provided in Chapter 12 Materials and Waste.

10.9.3 Piling Risk Assessments may be required. As well as assessing controlled water risks, Piling Risk Assessments consider where preferential pathways might be created, which could allow the migration of ground gas or vapours generated from unknown infill. Piling Risk Assessments will be subject to agreement with the Environment Agency.

10.9.4 Geotechnical risks will be managed in accordance with HD 22/08 and the proposed GI will provide information to ensure that the potential for ground collapse or settlement is understood and that adequate foundation solutions are designed. Following the GI, the subsequent Ground Investigation Report will be used to inform the Geotechnical Design Report. The Geotechnical Design Report will include stability analyses and design calculations for new and modified earthworks and structures, ensuring their short- and long-term stability. Chemical testing will therefore be included in the proposed GI scope and an assessment of the aggressivity of the ground and groundwater conditions will be undertaken in accordance with BRE Special Digest[287].

10.9.5 Drainage design will consider the risks from any residual contamination and may be required to use lined drainage systems in areas where contamination may be left in-situ (see Chapter 8 Road Drainage and the Water Environment).

10.9.6 The Scheme will be operated in accordance with the relevant regulations and best practice guidance in applying Best Available Techniques and pollution prevention.

Mitigation measures

10.9.7 In addition to the completion of the proposed GI and risk assessments (human health, controlled waters, dewatering, piling and ground gas), mitigation measures to be incorporated into the construction process will include (but are not limited to):

- Health and safety Risk Assessment and Methods Statements (RAMS) and appropriate PPE for the protection of construction workers in accordance with the Control of Substances Hazardous to Health (COSHH) Regulations;
- Implementation of appropriate dust suppression measures/management plan to prevent migration of contaminated dust and fibres as appropriate;
- Working method statements during construction to manage groundwater and ensure that there is no run-off from the works, material/waste stockpiles

[287] British Research Establishment. (2005). Special Digest 1:2005 Concrete in aggressive ground, third edition. BRE Bookshop, Watford, United Kingdom.

or storage containers into adjacent drains; in accordance with DEFRA and the Environment Agency's Pollution Prevention Guidance;

- Stockpile management (such as water spraying and avoiding over stockpiling to reduce compaction of soil and loss of integrity) and timely removal of stockpiled soil to prevent windblown dust and surface water run-off;
- Implementing (if deemed appropriate from the findings of the proposed GI) the MMP or SWMP;
- Limiting the area of earthworks at any one time to reduce temporary effects on topography, soil compaction and erosion;
- Limiting the duration of soil exposure and timely reinstatement of vegetation or hardstanding to prevent soil erosion;
- Implementing appropriate pollution incident control measures e.g. plant drip trays and spill kits;
- Assessment of soils to determine whether they are hazardous or non-hazardous in line with waste classification guidance, minimise disruption to any private/public water supplies etc;
- Implementing appropriate and safe storage of fuel, oils and equipment during construction; and
- Completion of a detailed UXO desk study to further assess the UXO hazard level within the Scheme, and the completion of a UXO survey prior to any ground disturbance.

10.9.8 If unexpected contamination is encountered during proposed earthworks, further assessment will be required. Following assessment, further mitigation measures such as remediation or removal of contamination may be necessary. If not remediated, laying of a clean capping layer may be required in areas of proposed soft landscaping.

10.9.9 Most of the Scheme area will be hardstanding during operation, except for soft landscaping along embankments, which will prevent direct contact and minimise the generation of dust. Therefore, direct contact and ingestion pathways and infiltration should be minimised during the operational phase.

Agricultural land

10.9.10 There is no environmental mitigation for loss of agricultural land. Financial compensation will be a matter for the District Valuer and is outside the scope of the assessment.

10.9.11 Engineered and other mitigation measures to minimise construction impacts on agricultural soils will be agreed with land owners and tenants before and during the construction process. Proposed measures are:

- Demarcation of the construction working corridor once defined, in order to prevent disturbance to adjacent land;
- Implementation of dust control measures (see Chapter 5 Air Quality and Chapter 6 Noise and Vibration);

- Diversion or restoration of any land drainage systems affected by the engineering works;
- Restoration of land occupied or disturbed during the construction process that is not permanently acquired for engineering and landscaping to a condition equivalent to its original. It will be subject to an aftercare period (duration to be agreed), during which time problems with settlement, drainage and weed infestation will be rectified; and
- The quality and quantity of soil on-site will be maintained by implementing appropriate techniques for stripping, stockpiling and reinstatement, in accordance with Defra's 2009 Code of Practice for the Sustainable Use of Soils on Construction Sites. This will be included in the OEMP/MMP.

10.10 Assessment of effects

Effects associated with land contamination

10.10.1 The land contamination impact assessment is summarised in Table 10.19 below. The full land contamination impact assessment is provided in Appendix G.1 in Volume 2.

Table 10.19: Land contamination impact assessment summary

Source	Receptor	Pathway	Significance of effect (construction without mitigation)	Significance of effect (construction with mitigation)	Significance of effect (operation)
Potential contaminants in soil / groundwater and gases / vapours associated with the following on-site sources: Made Ground or infilled ground of unknown physical and chemical quality (WWI trenches, road construction/ embankments); and soil affected by particulate fallout from vehicles, and spills and leaks from vehicles using the roads.	Human Health (on-site) Construction workers and site workers	Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres during stripping earthworks for soakaways.	N/A: There are no baseline risks to compare the construction without mitigation risks against. Construction without mitigation risks have been assumed to be moderate adverse to consider worst-case.	N/A: There are no baseline risks to compare the construction with mitigation risks against. The construction with mitigation is assumed to have better than worst case scenario, however the receptor is still present, therefore deemed a minor adverse effect.	Receptor not present during operation
		Inhalation, ingestion and dermal contact with contaminants within groundwater.			
		Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion.			
		Inhalation of vapours from soil and/or groundwater.			
	Human Health (off-site) Local residents Workers and visitors at nearby commercial premises and recreational facilities Members of the public using public rights of way (non motorised users)	Inhalation, ingestion and dermal contact with contaminants in windblown soil-derived dust/fibres.	Minor adverse	Negligible	Minor beneficial
		Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion.	Minor beneficial	Minor beneficial	Minor beneficial
		Inhalation of vapours from soil and/or groundwater.	Minor adverse	Minor adverse	Negligible

Source	Receptor	Pathway	Significance of effect (construction without mitigation)	Significance of effect (construction with mitigation)	Significance of effect (operation)
	Controlled Waters (on-site) Groundwater (localised superficial Secondary 'A' aquifer within Thanet Formation and bedrock Principal aquifers) Outer zone SPZ	Leaching/ vertical migration of contaminants in soils to underlying groundwater.	Minor adverse	Negligible	Minor beneficial
		Vertical migration of contaminants via preferential pathways such as via piles to deeper groundwater.	Minor adverse	Negligible	Minor beneficial
		Lateral migration of contamination in groundwater.	Minor adverse	Negligible	Minor beneficial
		Migration of contaminants entrained in surface water run-off.	Moderate adverse	Negligible	Minor beneficial
	Controlled Waters (off-site) Inner zone SPZ	Leaching/ vertical migration of contaminants in soils to underlying groundwater.	Minor adverse	Negligible	Minor beneficial
		Lateral / vertical migration of contamination in groundwater or to deeper groundwater.	Minor adverse	Negligible	Minor beneficial
		Migration of contaminants entrained in surface water run-off.	Moderate adverse	Negligible	Minor beneficial
	Ecology Ancient Woodland	Migration of contaminants entrained in surface water run-off.	Minor adverse	Negligible	Minor beneficial
	Property (on-site) Piles and other	Chemical attack from aggressive chemical constituents in soil or groundwater.	Minor adverse	Negligible	Minor beneficial

Source	Receptor	Pathway	Significance of effect (construction without mitigation)	Significance of effect (construction with mitigation)	Significance of effect (operation)
	foundations Underground services	Migration of ground gases or vapours along preferential pathways including permeable ground, services trenches and service entry points and accumulation in enclosed spaces such as services ducts or access points.	Minor beneficial	Minor beneficial	Minor beneficial
	<u>Property (off-site)</u> Residential, commercial and light industrial properties Underground services	Chemical attack from aggressive chemical constituents in soil or groundwater.	Minor adverse	Negligible	Minor beneficial
		Migration of ground gases or vapours along preferential pathways including permeable ground, services trenches and service entry points and accumulation in enclosed spaces such as services ducts or access points.	Minor beneficial	Minor beneficial	Minor beneficial
Potential contaminants in soil / groundwater and gases / vapours associated with the following off-site sources: Made Ground or infilled ground of unknown physical and chemical quality (pits, quarries, WWI trenches, road	<u>Human Health (on-site)</u> Construction workers and site workers	Inhalation, ingestion and dermal contact with contaminants in windblown soil-derived dust/fibres.	N/A: There are no baseline risks to compare the construction without mitigation risks against. The construction without mitigation risks	N/A: There are no baseline risks to compare the construction with mitigation risks against. The construction with mitigation is assumed to have better than worst	Receptor not present during operation
		Ingestion and dermal contact with contaminants within groundwater.			
		Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion.			

Source	Receptor	Pathway	Significance of effect (construction without mitigation)	Significance of effect (construction with mitigation)	Significance of effect (operation)
construction/ embankments, infilled sheep washes); historical quarrying activities (including kiln); farming activities (including the two former sheep washes); inactive service stations (Gleneagles Garage and Shell Garage); Commercial and light industrial land uses along Church Lane (machinery suppliers, agricultural machinery servicing, slate producers and an MOT centre) and along the old Maidstone Road (glass producers); tanks; former builder's merchants; and unclassified waste storage/ burning on private properties.		Inhalation of vapours in the soil and/or groundwater.	have therefore been assumed to be moderate adverse to consider worst-case.	case scenario, however the receptor is still present, therefore deemed a minor adverse effect.	
	Controlled Waters (on-site) Groundwater (localised superficial Secondary 'A' aquifer within Thanet Formation and Bedrock Principal aquifers) Outer SPZ	Lateral migration of contamination in groundwater.	Negligible	Negligible	Minor beneficial
		Migration of contaminants entrained in surface water run-off.	Minor adverse	Negligible	Minor beneficial
	Property (on-site) Piles and other foundations Underground services	Chemical attack from aggressive chemical constituents in groundwater.	Minor adverse	Negligible	Minor beneficial
		Migration of ground gases or vapours along preferential pathways including permeable ground, services trenches and service entry points and accumulation in enclosed spaces such as services ducts or access points.	Minor beneficial	Minor beneficial	Negligible

10.10.2 If no mitigation measures are implemented, the construction phase impacts associated with potential on-site sources have been typically assessed as minor beneficial to moderate adverse.

10.10.3 With the implementation of mitigation measures through design and through the construction phase, impacts to receptors during construction have been assessed as negligible to minor beneficial.

10.10.4 Compared to the existing baseline, the level of risk to receptors is expected to remain generally the same or reduce due to the implementation of mitigation measures.

10.10.5 During the operational phase, with mitigation measures incorporated within the design, there will be an overall betterment of the land. An overall negligible to minor beneficial effect is anticipated, associated with the removal and mitigation of identified contamination sources which are considered to pose a risk (as deemed necessary from quantitative risk assessments undertaken as part of detailed design).

10.10.6 The predicted effects are considered likely to be permanent. With the implementation of mitigation measures, the anticipated negligible and minor effects are not considered to be significant.

Effects associated with geomorphology and ground stability

10.10.7 A qualitative approach has been taken to assess the potential effects of the overall Scheme on geomorphology and ground stability features. These were all assigned a low value based on the rationale presented in Table 10.4. Mitigation methods have been factored in to the geomorphology and ground stability impact assessment, with the proposed ground investigation expected to provide information related to the identified potential risks. The assessment is summarised in Table 10.20.

Table 10.20: Geomorphology and ground stability impact assessment

Topic	Feature	Value	Construction with mitigation		Operation	
			Magnitude of impact	Significance of effect	Magnitude of effect	Significance of effect
Topography	Aesthetics	Low	Low	Minor adverse	Negligible	Negligible
Changes in physical properties and ground stability	Soil erosion	Low	Low	Minor adverse	Negligible	Negligible
	Collapsible ground (including cavities from mining)	Low	Medium	Minor adverse	Negligible	Negligible
	Landslides	Low	Medium	Minor / moderate beneficial	Negligible	Negligible

Topic	Feature	Value	Construction with mitigation		Operation	
			Magnitude of impact	Significance of effect	Magnitude of effect	Significance of effect
	Running sands	Low	Medium	Minor / moderate beneficial	Negligible	Negligible
	Shrinking or swelling clay	Low	Low	Minor adverse	Negligible	Negligible
	Dissolution	Low	Medium	Minor / moderate adverse	Negligible	Negligible
Other geological risk	UXO	Low	Medium	Minor adverse	Negligible	Negligible

10.10.8 The magnitude of impact that construction will have on topography is considered low as there will be only minor, localised topographical changes. The effects on topography resulting from the Scheme are considered permanent, although temporary effects are anticipated which are associated with the creation of temporary stockpiles during construction. The effect on topography is considered to be minor adverse during construction and negligible during operation and is therefore considered not significant.

10.10.9 Physical geological features have been assessed as having low value, as the attributes only possess characteristics which are locally significant (if deemed significant at all). Changes in physical properties during construction or ground stability include:

- Soil erosion. There is likely to be an increase in soil erosion as a result of the stripping of topsoil, vegetation clearance, earthworks, temporary stockpiling and the movement of heavy plant during the construction phase of the Scheme. There is also potential for increased run-off with a high sediment load during earthworks to impact surface water run-off. Mitigation measures listed in Section 10.9 are expected to reduce the potential for soil erosion and areas required for temporary works will be reinstated. Consequently, the effect on soil erosion during construction is considered temporary, minor adverse and during operation the effect is considered negligible, therefore the effect of the development is deemed not significant;
- Collapsible Ground. There is a very low potential for collapsible ground and a low potential for shrinking or swelling clay under baseline conditions. The likely degree of change to these risk ratings as a result of the Scheme is considered negligible and the significance of the effect is considered to be negligible and not significant;
- Landslides/subsidence. For most of the Scheme there is generally a low risk of landslides, with localised areas deemed to be at moderate risk, associated with the embankment on the southern side of the viaduct

between the old Maidstone Road; the west-bound on-slip and east of the old Maidstone Road, to the north of the M5, and land between Honeycrock Hill and Amels Hill roads, to the west of A249. If the proposed GI identifies a risk, structures within the vicinity will be mitigated by design. The significance of the effect is therefore, considered to be negligible and not significant;

- Running Sands. There are localised areas of a moderate hazard potential of running sands anticipated where the Thanet Formation is present. Where loose sands are identified during the proposed GI, appropriate mitigation measures (such as excavation and replacement with more competent material) will be incorporated into the design. Consequently, the effect the development of the Scheme has on running sands is considered to be permanent minor/moderate beneficial and significant; and
- Dissolution. White Chalk has the potential to dissolve. Soakaways and other drainage where water is discharged to ground have the potential to preferentially dissolve chalk. The proposed GI will assess the increased risk of dissolution and appropriate mitigation will be implemented during detailed design. The significance of the effect during construction and operation is considered to be minor/moderate adverse and negligible respectively and therefore not significant.

10.10.10 Suitable design will minimise geomorphology and ground stability impacts. This will therefore further reduce impacts to physical properties and ground instability. Consequently, the overall effect of the Scheme on geomorphology and ground stability is considered permanent and negligible/minor beneficial.

Effects associated with impacts on agricultural land

10.10.11 The significance of effect of impacts on agricultural holdings, before and after mitigation (during construction) has been applied, is summarised in Table 10.21.

Table 10.21: Significance of effect of impacts on agricultural holdings in construction phase

Holding	Sensitivity	Magnitude of impact	Effect	Mitigation	Residual effect	Impact	Effect	Mitigation	Residual effect
E.J. Mackelden & Sons (Bobbing) Limited,	Medium	Negligible Loss of 7.8 ha (0.8% of holding)	Neutral	None	Neutral	Negligible Dust affecting neighbouring crops	Neutral	Dust control	Neutral
Thrognall Farm	Medium	Negligible Loss of 1.8 ha (2.6% of holding)	Neutral	None	Neutral	Moderate Dust affecting adjacent fruit trees	Moderate adverse	Dust control	Slight adverse
Grass field between A269 and Maidstone Road	Low	Minor Loss of 0.9 ha (30% of holding)	Slight adverse	None	Slight adverse	Negligible Dust affecting neighbouring crops	Neutral	Dust control	Neutral
Whipstake Farm	Medium	Minor Loss of 1.2 ha (6.7% of holding)	Slight adverse	None	Slight adverse	Dust and noise affecting crops and livestock	Slight adverse	Noise and dust control	Slight adverse

10.10.12 Construction effects are minor or negligible and the effects with mitigation are neutral or slight adverse. The holding most at risk is Thrognall Farm, where fruit trees are within 25 m of the construction boundary and adequate dust control measures must be put in place to protect the crop.

10.10.13 For agricultural soils the effects are assessed on the basis of permanent loss of BMV land to the Scheme (Table 10.22). This land will be taken out of agricultural use at the start of construction and the effect will continue into the operational phase. The residual effect of a loss of 10.3 ha is assessed as moderate adverse but this is well below Natural England's 20 ha threshold of significance for loss of BMV soils.

Table 10.22: Construction and operation effects of loss of BMV land

ALC Grade	Sensitivity	Magnitude of impact	Mitigation	Residual effect
2 and 3a	High	Moderate adverse Loss of 10.3 ha of BMV land	None	Moderate adverse

10.10.14 The impact and effect of permanent land-take will continue into the operational phase. Dust and noise will cease to be impacts at the end of construction. The operation effects, which are all neutral or slight, are summarised in Table 10.23.

Table 10.23: Operation effects of the Scheme on agricultural holdings

Holding	Sensitivity	Magnitude of impact	Effect	Mitigation	Residual effect
E.J. Mackelden & Sons (Bobbing) Limited,	Medium	Negligible Loss of 7.8 ha (0.8% of holding)	Neutral	None	Neutral
Thrognall Farm	Medium	Negligible Loss of 1.8 ha (2.6% of holding	Neutral	None	Neutral
Grass field between A269 and Maidstone Road	Low	Minor Loss of 0.9 ha (30% of holding)	Slight adverse	None	Slight adverse
Whipstake Farm	Medium	Minor Loss of 1.2 ha (6.7% of holding)	Slight adverse	None	Slight adverse

Significant effects

10.10.15 Table 10.19 and Table 10.20 show that with the implementation of mitigation measures, there are no predicted significant adverse effects with regards to land contamination, geomorphology and ground stability.

10.10.16 With mitigation implemented, a number of identified land contamination effects are deemed minor beneficial and permanent to identified receptors, as any

unacceptable contamination or unstable ground conditions identified within the proposed GI will be remediated to improve baseline conditions.

10.10.17 Table 10.22 identifies that for the permanent loss of BMV land, the effect is moderate adverse. However, the loss of 10.3 ha of BMV land is well below Natural England's 20 ha threshold of significance. No significant effects are anticipated for the permanent loss of land from individual agricultural holdings.

Residual effects

10.10.18 Residual effects typically refer to the long-term effects of the Scheme and relate to the completed and operational development, taking into account any mitigation measures. No significant residual effects with regards to land contamination and geomorphology and ground stability are expected post-construction of the Scheme.

10.10.19 No significant effects are anticipated to agricultural holdings. Although 10.3 ha of BMV land will be lost permanently, this is well below Natural England's 20 ha threshold of significance.

10.11 Cumulative effects

10.11.1 The cumulative effects are those that result from the additive impacts of both the Scheme's components and any past, present or reasonably near-future development within the study area.

10.11.2 Development could potentially affect surface water, geology and soils as a resource, topography, groundwater and form PCLs without implementation of design and mitigation measures.

10.11.3 Proposed development that has been identified within the geology and soils study area include:

- Land at Woodgate Lane (Ref. 15/507804/FUL); and
- Builder's Yard (18/505147/PNP).

10.11.4 With respect to land contamination, these developments are required to ensure that the planned development is suitable for its intended use and that mitigation and control measures will be adopted during the construction phase to reduce impacts to the environment. Therefore, a low potential for cumulative impacts is predicted during the construction phase.

10.11.5 It is assumed that the identified off-site developments will be operated in accordance with granted consents and the relevant regulations and best practice guidance in applying Best Available Techniques and pollution prevention, therefore, a low potential for cumulative impacts is predicted during operation.

10.12 Monitoring

10.12.1 A GI is proposed for the Scheme to inform design and appropriate mitigation measures. The GI will allow for the installation of groundwater and ground gas monitoring wells and a subsequent preliminary monitoring programme to confirm baseline conditions.

10.12.2 Given the timescales associated with the GI, the subsequent monitoring data will not be available until after the submission of the ES, however the data will be submitted to the Environment Agency for review prior to the commencement of any groundworks associated with the Scheme.

10.12.3 Monitoring will be carried out after the GI. Monitoring is proposed to take place pre-construction, during construction and post construction, in order to assess any changes imposed on the Scheme by the proposed works.

10.12.4 Any disturbed land restored to farming will be subject to an agreed aftercare period, during which time any problems with settlement, drainage and noxious weeds will need to be rectified.

10.13 Summary

10.13.1 The anticipated effects of the Scheme on geology and soils have been assessed in this chapter in accordance with the regulatory policy framework presented in Section 10.3.

10.13.2 With the application of appropriate mitigation measures and subject to the proposed GI confirming expected ground conditions, the Scheme has been assessed as having temporary negligible to minor adverse effect during the construction phase (not significant). The operational phase has been assessed (assuming design and mitigation measures will be incorporated) as having a permanent negligible to minor beneficial effect and has therefore been assessed as being not significant. The material identified to contain asbestos within the vicinity of the proposed link road is required to be extracted and disposed of in an appropriate manner, to a landfill which accepts waste containing asbestos.

10.13.3 With respect to geomorphology and ground stability, the assessment indicated that the construction phase and the operational phase will have a negligible to minor adverse impact, and this has been assessed as not significant.

10.13.4 No significant effects are anticipated for the permanent loss of agricultural land from individual agricultural holdings. The permanent loss of 10.3 ha of BMV land is below Natural England’s 20 ha threshold of significance.

11. Cultural Heritage

11.1 Introduction

11.1.1 This chapter presents the results of the assessment for Cultural Heritage under the three sub-topics of archaeological remains, historic buildings and the historic landscape. Additional information to support this chapter is presented in the following appendices:

- Appendix H.1 in Volume 2 – M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report;[288]
- Appendix H.2 in Volume 2 – M2 Junction 5 Improvements, Further Archaeological Evaluation Report[289]; and
- Appendix H.3 in Volume 2 – Cultural Heritage:
  - Gazetteer of heritage assets;
  - Gazetteer of known events within the study area; and
  - Impact assessment tables.

11.2 Competent expert evidence

11.2.1 This Cultural Heritage chapter has been undertaken by Sandra Honeywell who is a chartered archaeologist holding full professional membership with the Chartered Institute for Archaeologists (MCIfA). Sandra Honeywell has over 14 years of knowledge and experience in heritage assessment and has used knowledge and professional judgement to undertake this assessment.

11.3 Legislative and policy framework

11.3.1 The legislative and policy framework relevant to this assessment is provided by the documents listed in Table 11.1 below.

Table 11.1: Legislation, regulatory and policy framework for cultural heritage

Scale	Legislation/ regulation	Summary of requirements
National	National Planning Policy Framework (NPPF) 2019	Section 16 of the NPPF sets out the Core Planning Principles of which 'Conserving and Enhancing the Historic Environment' is one. NPPF determines that heritage assets should be afforded proportionate weight to their significance when determining acceptable impacts on the asset or its setting. Developments affecting heritage assets are required to submit a statement describing the significance and any contribution of the assets setting. Any impact on a heritage asset should be weighed against public benefits of the proposal. Paragraphs 184, 189, 194, 196, 197 and 199 have been considered in this assessment.

[288] Oxford Archaeology, 2018. M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report
[289] Oxford Archaeology, 2018b. M2 Junction Improvements, Kent, Further Evaluation Report

Scale	Legislation/ regulation	Summary of requirements
	National Networks National Policy Statement (NN NPS)	The NN NPS recognises that construction and operation of national networks may have adverse impacts on the historic environment. The NN NPS reiterates the need for a heritage statement and that any potential impact should be viewed in light of social, environmental and economic benefits arising as a result of the Scheme. Substantial and total harm of a designated heritage asset should only occur in wholly exceptional circumstances. Historic Environment Policy is laid out in paragraphs 5.120 to 5.142 of the NN NPS.
	Planning Practice Guidance (PPG), 2018	Section 18a 'Conserving and Enhancing the Historic Environment' expands on NPPF Section 16 and should be read in conjunction with it. In relation to the Site, the key considerations are set out in the sections on non-designated heritage assets.
	Ancient Monuments and Archaeological Areas Act (1979)	Under the Ancient Monuments and Archaeological Areas Act 1979, the Secretary of State (Department of Culture, Media and Sport – DCMS) can schedule any site which appears to be of national importance because of its historic, architectural, traditional, artistic or archaeological interest. Additional controls are placed upon works affecting Scheduled Monuments and Areas of Archaeological Importance under the Act. The consent of the Secretary of State (DCMS), as advised by Historic England, is required for certain works affecting Scheduled Monuments. This legislation protects the archaeological heritage of England, Wales & Scotland.
	Planning (Listed Building and Conservation Areas) Act (1990)	In England, under Section 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990, the Secretary of State is required to compile lists of buildings of special architectural or historic interest, on advice from Historic England. Works affecting Listed Buildings are subject to additional planning controls administered by Local Planning Authorities. Historic England are a statutory consultee in certain works affecting Listed Buildings. Under certain circumstances, Listed Building Consent is required for works affecting Listed Buildings. The Act has created special controls for the demolition, alteration or extension of structures with particular architectural or historic interest. The listing system is administered by Historic England.
	Enterprise and Regulatory Reform Act (2013)	The Act aims at reforming the regulatory environment and cut certain legislation. Part 5 focuses on the reduction of legislative burdens and encompasses heritage planning, primarily focusing on Listed Buildings, heritage partnership agreements, and local Listed Buildings,
	Road Investment Strategy (RIS) and Strategic Business Plan 2015	Historic England has ring fenced £300 million in an Environment Fund to improve environmental performance, including for cultural heritage purposes. The strategy aims to enhance the setting and condition of cultural heritage and historic features in proximity to the Strategic Road Network.
Local	Maidstone Borough Council, Local Plan,	The following policies are applicable to the historic environment: • Policy SP18 'Historic environment'.

Scale	Legislation/ regulation	Summary of requirements
	adopted October 2017	
	Swale Borough Council, Local Plan (Bearing Fruits), adopted July 2017	Policy CP 8 'Conserving and enhancing the historic environment' forms part of Swale Borough Council's Core Planning Policy. Other relevant policies include: • Policy DM34: Scheduled Monuments and archaeological sites; and • Policy DM35: Historic parks and gardens.

Table Source: Various

11.3.2 In addition to the above, the following guidance has been considered in this chapter:

- Standards and Guidance for Historic Environment Desk-Based Assessment;[290]
- Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment;[291]
- Managing Significance in Decision-Taking in the Historic Environment, Historic Environment Good Practice Advice in Planning Note 2;[292]
- Preserving Archaeological Remains Decision-taking for Sites under Development;[293]
- The Setting of Heritage Assets, Historic Environment Good Practice Advice in Planning Note 3, 2nd edition;[294] and
- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 2, (HA208/07).[295]

11.4 Study area

11.4.1 The study area for archaeological remains, historic buildings and the historic landscape was defined as extending 200 m in all directions from the Scheme boundary. This is in line with the requirements of DMRB Volume 11 Section 3, Part 2 (HA208/07)[296] Annex 5: Archaeological Remains.

11.4.2 Annexes 6 and 7 of HA208/07 do not identify a set distance for the historic buildings or historic landscape subtopic study areas. Annex 6 (historic buildings) requires that the study area is defined according to the sensitivity of the receiving

[290] Chartered Institute for Archaeologists, 2017. Standards and guidance for historic environment desk-based assessment
[291] English Heritage, 2008. Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment
[292] Historic England, 2015. Managing Significance in Decision-Taking in the Historic Environment Historic Environment Good Practice Advice in Planning Note 2
[293] Historic England, 2016. Preserving Archaeological Remains Decision-taking for Sites under Development
[294] Historic England, 2017. The Setting of Heritage Assets Historic Environment Good Practice Advice in Planning Note 3, 2nd edition;
[295] Highways Agency, Transport Scotland, Welsh Assembly Government and the Department for Regional Development Northern Ireland, 2007. Design Manual for Roads and Bridges, Volume 11, Section 3, Part 2. HA208/07. Cultural Heritage.
[296] Highways Agency, Transport Scotland, Welsh Assembly Government and the Department for Regional Development Northern Ireland, 2007. Design Manual for Roads and Bridges, Volume 11, Section 3, Part 2. HA208/07. Cultural Heritage.

environment, the potential impacts of the Scheme, and the type of assessment (HA208/07 para 6.4.1); whilst Annex 7 (historic landscape) identifies the need for the study to examine sufficient data at an appropriate level of detail to enable informed decisions to be made with confidence about the effect of the Scheme (HA208/07 para 7.4.3).

11.4.3 The 200 m study area was also employed for the historic building subtopic as it provides a suitable area for identification of impacts from the Scheme on non-designated historic buildings, in line with the requirements of Annex 6 of DMRB Volume 11 Section 3, Part 2 (HA208/07). The 200 m study area was also employed for designated historic buildings, supplemented by additional data gathering for an area extending up to 1 km from the Scheme as described at paragraph 11.4.5 below.

11.4.4 A 200 m study area was also employed for the historic landscape subtopic. Given the nature of the historic landscape in the area surrounding the Scheme, characterised principally by the presence of small to medium sized character units of post-medieval and modern date, this study area is considered to provide a good understanding of baseline conditions and enable a robust assessment of impact for this subtopic, in line with the requirements of Annex 7 of DMRB Volume 11 Section 3, Part 2 (HA208/07).

11.4.5 In order to identify designated assets located outside the study area for which the setting might be impacted by construction or operation of the Scheme, data on designated assets (Scheduled Monuments, Listed Buildings, Registered Parks and Gardens, Registered Battlefields, Protected Military Remains and Conservation Areas) was gathered for an area extending 1 km from the Scheme. The potential for impacts on the setting of these assets was assessed based on the Zone of Theoretical Visibility (ZTV) for the Scheme (refer to Chapter 9 Landscape and Visual), verified by a site inspection undertaken on Wednesday 14th November 2018. No potential for impacts on designated heritage assets outside the 200 m study area was identified as a result of this.

11.4.6 The study area is shown on Figures 11.1 to 11.4 in Volume 3.

11.5 Assessment methodology

11.5.1 The historic environment comprises the following designated and non-designated heritage assets and other features or remains of historic interest:

- World Heritage Sites;
- Scheduled Monuments;
- Listed Buildings;
- Registered Parks and Gardens;
- Conservation Areas;
- Registered Battlefields;
- Buildings and structures of historic interest (not listed);
- Known archaeological sites and areas of archaeological potential;

- National Trust Inalienable Land;
- Historic landscapes; and
- Findspots.

11.5.2 Historic environment baseline data was collected from the following sources:

- Environmental reports prepared for preceding stages of the project comprising:
  - M2 Junction 5 Improvements Study Environmental Study Report[297];
  - M2 Junction 5 Improvements Scheme Environmental Scoping Report[298];
  - M2 Junction 5 Improvements Scheme, Environmental Assessment Report Addendum[299];
- Data from the Kent Historic Environment Record (KHER) on designated and undesignated heritage assets, and historic landscape characterisation data (obtained 26/04/18);
- Data from the National Heritage List of England (NHLE) relating to designated heritage assets;
- M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report[300] (Appendix H.1 in Volume 2);
- Geophysical Survey Report G1615, M2 Junction 5 Improvements, Kent[301] (Refer to Appendix H.1 in Volume 2);
- Geophysical Survey Report, M2 Junction 5 Improvements[302] (refer to Appendix H.1 in Volume 2);
- Historic tithe maps held by the Kent Record Office; and
- Site inspection undertaken on 14th November 2018.

11.5.3 A gazetteer of designated and non-designated heritage assets which are located within the study area is presented in Appendix H.3 in Volume 2. A gazetteer of the known events within the study area can be found in Appendix H.3 in Volume 2.

11.5.4 All heritage figures produced for this chapter are presented in Volume 3. These include figures showing the below information:

- Designated and non-designated heritage assets (Figure 11.1 in Volume 3);
- Historic landscape characterisation (Figure 11.2 in Volume 3);
- Previous archaeological fieldwork (Figure 11.3 in Volume 3); and
- Archaeological investigation areas (Figure 11.4 in Volume 3).

[297] Highways England, 2016. M2 Junction 5 Improvements Study Environmental Study Report.
[298] WSP. 2017. M2 Junction 5 Improvements Scheme, Environmental Scoping Report.
[299] WSP. 2018. M2 Junction 5 Improvements Scheme, Environmental Assessment Report Addendum.
[300] Oxford Archaeology, 2018. M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report.
[301] GSB Prospection, 2016. Geophysical Survey Report G1615, M2 Junction 5 Improvements, Kent.
[302] Sumo Survey. 2017. M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report.

Methodology for assessment of value, magnitude and significance of impact

11.5.5 The methodology for assessing potential beneficial or adverse impacts and likely effects on the historic environment is based on guidance provided in the Design Manual for Roads and Bridges (DMRB) Volume 11, HA 208/07, Annexes 5, 6 and 7. DMRB guidance determines likely positive or negative effects through identifying an asset's value or significance against the degree of change that the Scheme would cause through construction and operational phases and under various types of impact including direct, indirect, permanent, temporary, residual and cumulative.

11.5.6 The guidance assigns a value to each type of heritage asset, whether individual or collective in the DMRB Volume 11, Section 3, Part 2 HA 208/07 Cultural Heritage. This is set out in Table 11.2 below.

Table 11.2: Criteria for the assessment of value of heritage assets

	Archaeological remains	Historic buildings	Historic landscape
Very High	World Heritage Sites (including nominated sites). Assets of acknowledged international importance. Assets that can contribute significantly to acknowledged international research objectives.	Structures inscribed as of universal importance as World Heritage Sites. Other buildings of recognised international importance.	World Heritage Sites inscribed for their historic landscape qualities. Historic landscapes of international value, whether designated or not. Extremely well preserved historic landscapes with exceptional coherence, time-depth, or other critical factor(s).
High	Scheduled Monuments (including proposed sites). Undesignated assets of schedulable quality and importance. Assets that can contribute significantly to acknowledged national research objectives.	Scheduled Monuments with standing remains. Grade I and Grade II* Listed Buildings. Other Listed Buildings that can be shown to have exceptional qualities in their fabric or historical associations not adequately reflected in the listing grade. Conservation Areas containing very important buildings. Undesignated structures of clear national importance.	Designated historic landscapes of outstanding interest. Undesignated landscapes of outstanding interest. Undesignated landscapes of high quality and importance, and of demonstrable national value. Well preserved historic landscapes, exhibiting considerable coherence, time-depth or other critical factor(s).
Medium	Designated or undesignated assets that contribute to regional research objectives.	Grade II Listed Buildings. Historic (unlisted) buildings that can be shown to have exceptional qualities in their fabric or historical associations. Conservation Areas containing buildings that contribute significantly to its historic character. Historic Townscape or built-up areas with important historic integrity in their buildings or built settings (e.g. including street furniture and other structures).	Designated special historic landscapes. Undesignated historic landscapes that would justify special historic landscape designation, landscapes of regional value. Averagely well-preserved historic landscapes with reasonable coherence, time-depth or other critical factor(s).
Low	Designated and undesignated assets of local importance. Assets compromised by poor preservation and/or poor survival of contextual associations. Assets of limited value, but with potential to contribute to local research objectives.	'Locally Listed' buildings (Scotland Category C(S) Listed Buildings). Historic (unlisted) buildings of modest quality in their fabric or historical association. Historic Townscape or built-up areas of limited historic integrity in their buildings or built settings (e.g.	Robust undesignated historic landscapes. Historic landscapes with importance to local interest groups. Historic landscapes whose value is limited by poor preservation and/or poor survival of contextual associations.

	Archaeological remains	Historic buildings	Historic landscape
		including street furniture and other structures).	
Negligible	Assets with very little or no surviving archaeological interest.	Buildings of no architectural or historical note; buildings of an intrusive character.	Landscapes with little or no significant historical interest.
Unknown	The importance of the resource has not been ascertained.	Buildings with some hidden (i.e. inaccessible) potential for historic significance.	N/A

Table Source: DMRB Volume 11, Section 3, Part 2 HA208/07 Cultural Heritage, Annexes 5, 6 and 7

11.5.7 The likely impact of the Scheme on heritage assets will be determined through the identification of value and assessing the scale of impact the Scheme would have on the significance of an asset.

11.5.8 Table 11.3 below summarises the criteria for establishing the magnitude of impacts on heritage assets. This is based on the guidance provided in Annexes 5, 6 and 7 of DMRB Volume 11, Section 3, Part 2 HA208/07 Cultural Heritage.

Table 11.3: Criteria for assessment of magnitude of impact

Magnitude of impact	Description of nature of change
Major Adverse	Change to all or most of the asset, or loss of an asset's significance as a result of changes to its physical form or setting. For example, this would include demolition, removal of physical attributes critical to an asset, loss of all archaeological interest or the transformation of an asset's setting in a way that fundamentally compromises its ability to be understood or appreciated. The scale of change would be such that it could result in a designated asset being undesignated or having its level of designation lowered.
Moderate Adverse	Change to many key elements of an asset, such that the asset is significantly modified as a result of changes to its physical form or setting. For example, this could include: physical alterations that remove or alter some elements of significance, but do not substantially alter the overall significance of the asset; notable alterations to the setting of an asset that affect our appreciation of it and its significance; or the unrecorded loss of archaeological interest.
Minor Adverse	Limited harm to an asset's significance as a result of changes to its physical form or setting. For example, this could include: physical changes that alter some elements of significance but do not noticeably alter the overall significance of the asset; and small-scale alterations to the setting of an asset that hardly affect its significance.
Negligible	Very minor changes to setting or form of the asset.
No Change/ Neutral	No appreciable change to an asset's significance.
Minor Beneficial	Limited improvement of an asset's significance as a result of changes to its physical form or setting. For example, this could include: physical changes that reveal or conserve some elements of significance but do not noticeably alter the overall significance of the asset; or small-scale alterations to the setting of an asset that improve our ability to appreciate it.
Moderate Beneficial	Notable enhancement of an asset's significance as a result of changes to its physical form or setting. For example, this could include: physical alterations that conserve or restore elements of significance; notable alterations to the setting of an asset that improve our appreciation of it and its significance; or changes in use that help safeguard an asset.
Major Beneficial	Substantial enhancement of an asset's significance as a result of changes to its physical form or setting. For example, this could include: major changes that conserve or restore elements of high significance; alterations to the setting of an asset that very substantially improve our appreciation of it and its significance; or

Magnitude of impact	Description of nature of change
	changes in use that safeguard an asset, e.g. by taking it off the At Risk Register.

Table Source: Based on DMRB Volume 11, Section 3, Part 2 HA208/07 Cultural Heritage

11.5.9 Table 11.4 below shows how the significance of effects is determined. This combines the value of the heritage asset and the scale of change (impact) to provide the measure of effect.

Table 11.4: Significance of effects matrix

Value/sensitivity	Magnitude of impact				
	Major	Moderate	Minor	Negligible	No change
Very high	Very large	Large or very large	Moderate or large	Slight	Neutral
High	Large or very large	Moderate or large	Slight or moderate	Slight	Neutral
Medium	Moderate or large	Moderate	Slight	Neutral or slight	Neutral
Low	Slight or moderate	Slight	Neutral or slight	Neutral or slight	Neutral
Negligible	Slight	Neutral or slight	Neutral or slight	Neutral	Neutral

Table Source: DMRB Volume 11, Section 3, Part 2 HA 208/07 Cultural Heritage

11.5.10 Generally, moderate to very large adverse or beneficial effects are considered to be 'significant' in terms of EIA regulations.

Assessment of impacts on setting

11.5.11 Impacts on the setting of heritage assets were assessed in accordance with the guidance provided in The Setting of Heritage Assets, Historic Environment Good Practice Advice in Planning Note 3[303]. This guidance identifies a staged approach to the assessment of impacts on setting summarised below:

1. Identify which heritage assets and their settings are affected;
2. Assess the degree to which these settings make a contribution to the significance of the heritage asset(s) or allow significance to be appreciated;
3. Assess the effects of the proposed development, whether beneficial or harmful, on that significance or on the ability to appreciate it;
4. Explore ways to maximise enhancement and avoid or minimise harm; and
5. Make and document the decision and monitor outcomes.

11.6 Assumptions and limitations

11.6.1 This assessment is based upon data obtained from publicly accessible archives, as described in the Assessment Methodology in Section 11.4, and the results of

[303] Historic England, 2017. The Setting of Heritage Assets, Historic Environment Good Practice Advice in Planning Note 3.

archaeological fieldwork undertaken for this project. Heritage assets within 200 m of the Scheme boundary have been identified. Data from the Kent Historic Environment Record (KHER) was obtained in April 2018.

11.6.2 The information presented in the gazetteer (see Appendix H.3 in Volume 2) regarding known heritage assets is current to this date. All designated asset data (Scheduled Monuments and Listed Buildings) was downloaded from Historic England on the 23rd November 2018 and is correct to that date. All the work carried out in this report is based upon Atkins Heritage's professional knowledge and understanding of current (November 2018) and relevant United Kingdom standards and codes, technology and legislation.

11.7 Baseline conditions

11.7.1 The following section outlines the known and potential historic environment resource present within the Scheme boundary and study area. A summary of the baseline conditions is presented below.

11.7.2 A total of 33 heritage assets have been identified within the study area. These assets comprise:

- One Scheduled Monument;
- Six Listed Buildings;
- 18 non-designated heritage assets; and
- Eight non-designated historic landscape types (HLTs).

11.7.3 The KHER records an Archaeological Notification Area along the base of the Stockbury Valley extending from the south of the study area northwards to the M2 due to the multi-period potential of this area. The area around the Scheduled Monument of the Ringwork and Baileys at Church Farm (1009949) is identified as an Area of Archaeological Potential. Definition of these areas is a planning tool used by the KHER to identify the need for consultation with the County Archaeologist about development in these areas, and they have no statutory function.

11.7.4 Assets are referred to in the text by their NHLE or KHER reference number. Assets recorded on both the NHLE and KHER are referred to by their NHLE reference. Where assets have been identified as a result of fieldwork undertaken for this project, they are prefixed with ATK.

11.7.5 Heritage assets are shown on Figures 11.1 and 11.2 in Volume 3 and listed in the gazetteer presented in Appendix H.3 in Volume 2.

Designated Assets

11.7.6 There are no World Heritage Sites, Registered Parks and Gardens, Conservation Areas, or Registered Battlefields within the Scheme boundary or study area.

Scheduled Monuments

11.7.7 There is one Scheduled Monument within the study area comprising the Ringwork and Baileys at Church Farm (1009949) (refer to Figure 11.1 in

Volume 3).

11.7.8 Ringworks date from the late Anglo-Saxon to Norman periods and comprise a fortified enclosure, defined by a substantial bank and ditch. These functioned as military strongholds, or sometimes as defended aristocratic or manorial settlements. The Ringwork and Baileys at Church Farm comprises a substantial and well-preserved earthwork. The asset is formed by the ringwork which originally contained the main residential buildings, located to the northwest of the site and defined by a substantial ditch. To the southeast of this is a semi-circular inner bailey, defined by a ditch and bank, and a larger outer bailey enclosed by a ditch. The asset has been subject to some damage as a result of the establishment of a farm to the north of the scheduled area (Church Farmhouse and Church Farm Cottage, Grade II Listed Building, 1299288), quarrying and dumping. Despite this, the Scheduled Monument remains well-preserved.

11.7.9 The hilltop setting of the Scheduled Monument to the southwest of the Scheme contributes to its value. The parish Church of St Mary Magdalene (1086193) is located directly to the north of the Scheduled Monument. Dating from the 12th century, the Church and Ringwork form a spatial and historic group, evidencing the close association of sacred and secular power during the medieval period. The hilltop location of the Ringwork also contributes to its value, suggesting a strategic role in controlling the local area and communication along the valley, as well as a symbolic role as the centre of secular power. Today, views from the Scheduled Monument look across a rural landscape characterised by the presence of enclosed fields and pockets of woodland. Glimpsed views of the A249 dual carriageway are visible from the asset and road noise is audible.

11.7.10 The Ringwork and Baileys at Church Farm is one of only *c*.60 surviving ringworks with baileys in England and contributes to our understanding of the Anglo-Saxon and Norman periods. The asset is of evidential value both due to its good preservation as an earthwork site and for its archaeological potential. Due to its national significance and designation as a Scheduled Monument, this asset has been assessed to be of high value.

Listed Buildings

11.7.11 One Grade I Listed Building, the Church of St. Mary Magdalene (1086193), is located approximately 245 m west of the Scheme.

11.7.12 The medieval parish Church of St. Mary Magdalene was built in the late 12th century in the Early Norman style. Constructed in flint with stone and brick dressings, the Church experienced several stages of development, with additions in the 13th and 15th centuries, and restoration in the 19th century. The Church is set within a small sub-rectangular churchyard which includes a number of Grade II Listed headstones (1186232, 1186237,1086194) and a Grade II Listed tomb (1336256).

11.7.13 The Church is set on the hilltop overlooking the Stockbury Valley, with long views from the churchyard across the valley to the southeast. Glimpsed views of the M2 are possible from the churchyard to the north and traffic noise is audible. The Church is located directly to the northeast of the Ringwork and Baileys at Church Farm (1009949), a Scheduled Monument. The topographic setting of the Church and its close physical and historic relationship with the Scheduled Monument contribute to its value. Together, the Church and Ringwork form a significant

cluster that evidences the close relation of sacred and secular power during the medieval period.

11.7.14 In consideration of its national significance and designation as a Grade I Listed Building, this asset has been assessed to be of high value.

11.7.15 A total of four gravestones and tombs within the churchyard are designated as Grade II Listed Buildings. These comprise two gravestones dating from the 17th and early 18th century decorated with cross bones (1086194; 1186232), a mid-18th century gravestone finished with foliated scrolls and a trumpet-playing cherub (1186237) and a table tomb of mid-18th century date ornamented with moulded plinth, corniced lid and gadrooned panels (1336256). The key attribute of these assets' settings is their physical and functional relationship with the Church of St Mary Magdalene and group value with other memorials in the graveyard. In consideration of their historic and architectural interest, and designation as Grade II Listed Buildings, these assets have been assessed to be of medium value.

11.7.16 Church Farmhouse and cottage (1299288) is designated as a Grade II Listed Building, and is formed by a two-storey house, with attached lower two-storey cottage to the left constructed of red brick with a plain tile roof. The façade of the main house dates from the early 19th century and conceals a building dating to the 16th century or earlier, whilst the lower cottage is thought to date from the mid to late 18th century. Together they form an idiosyncratic building, characterised by contrasting height, the presence of half-hipped and gabled roofs to the front range, and contrasting regular and irregular fenestration between the farmhouse and cottage. Situated within the Ringwork and Baileys at Church Farm (1009949) and close to the Church of St Mary Magdalene (1086193), the Listed Building is believed formerly to have housed the local vicar.[304] The setting of the farmhouse in proximity to these assets, the survival of historic outbuildings to the north and the rural character of the surrounding landscape contributes to its value. The value of this grade II Listed Building has been assessed to be medium.

Non-designated heritage assets

11.7.17 A total of 26 non-designated heritage assets have been identified within the study area. These comprise:

- 13 archaeological and historic building assets recorded by the KHER;
- One asset identified from documentary sources and fieldwork (ATK4);
- Four assets identified during work undertaken for this project (ATK1, ATK2, ATK3 and ATK5); and
- Eight HLTs.

11.7.18 Geophysical survey and archaeological evaluation around Junction 5 were carried out in 2017 and 2018 for this project. This fieldwork identified evidence of prehistoric activity to the northwest and southeast of the junction, including a sizeable flint assemblage dating from the Mesolithic to Neolithic or Early Bronze Age periods, and two areas of smelting activity of Iron Age or early Roman date which included evidence of technological development towards more effective

[304] Listed building description

smelting techniques (ATK1, ATK2, and ATK3). Further detail on the findings of this work is provided in 11.7.27 to 11.7.46 below.

11.7.19 Further evidence of Roman activity is recorded by the KHER at asset MKE90925 to the south of the study area. A Roman cremation dating to 2nd or 3rd century AD was identified during a watching brief, accompanied by four pottery vessels and three copper alloy objects including a blade and a pin. The value of this asset has been assessed to be medium due to its potential to contribute to our understanding of funerary practices during the Roman period.

11.7.20 The majority of assets recorded within the study area are related to the development of the rural landscape in the post-medieval period. Vale House is recorded by the KHER as an extant historic farmstead (MKE85122). Now much altered, the large farmhouse survives, however much of the associated farmstead has been lost. Located directly to the south of the A249, the setting of the farm is dominated by noise and visual intrusion associated with the dual carriageway, although its setting remains rural in character to the south and southeast with the presence of a post-medieval fieldscape. The farm complex at Church Farm (MKE85050) is recorded on the KHER, where it is identified as being built on a loose courtyard plan with working agricultural buildings on four sides. The presence of large modern agricultural buildings is also noted. Also recorded on the KHER are the former locations of four now demolished farmsteads and outfarms[305] (MKE85152; MKE85153; MKE85155; MKE85156) identified by the Kent Farmsteads and Landscapes project; the site of a limekiln identified from historic mapping (MKE15784), any remains of which are likely to have been destroyed by excavation of the cutting for the A249 dual carriageway; and a milestone which remains adjacent to Maidstone Road, to the northeast of the study area.

11.7.21 With the exception of the limekiln (MKE15784), the value of these assets has been assessed to be low, due to their contribution to our understanding of development and exploitation of the local landscape in the post medieval period. The limekiln has been assessed to be of negligible value due to the likely removal or truncation of archaeological remains associated with this asset during construction of the existing dual carriageway.

11.7.22 The study area is located on the line of the Chatham Land Front. This was a defensive line established in World War 1 with the purpose of delaying a German invasion force and preventing its use of the London Road (now the A2) at its junction with the Maidstone Road (now the A249) (Anstee and Smith, ND[306]). The stop line ran from near Kemsley, southwest to Detling and Boxley Hill, passing through villages and hamlets along the Stockbury Valley.[307] The Front was formed by trenches, machine gun emplacements, redoubts, strong points, tunnels, artillery batteries, headquarters buildings, pillboxes and a telephone system (*Ibid*). Mapping of the defences undertaken in World War 1 shows a network of crenelated fire trenches, support and communication trenches, gun emplacements and batteries. Within the study area, these defensive works are represented by an extant pillbox located directly to the west of the Scheme (MKE40061); the site of a battery (MKE99573), which is now destroyed; the site

[305] An Outfarm is a multi-purpose farm building in an outlying area of a farm.
[306] Anstee, A. and Smith, V. ND. The Battle of Britain…that never was, a tour of Swale's forgotten Great War defences. http://khd.kentarchaeology.org.uk/wp-content/uploads/2014/06/swale-low-res.pdf
[307] WSP, 2017. M2 Junction 5 Improvements Scheme, Environmental Assessment Report, Appendix 7.1 Cultural Heritage Setting Assessment

of a second battery (MKE99599), which survives within the Scheduled Monument at Church Farm; and archaeological evidence of the trench network, which formerly ran to either side of the Stockbury Valley (MKE98280 and ATK4). A key attribute of the setting of these assets is the intervisibility between elements of the Stop Line, views along the Stockbury Valley and northwards towards potential invasion locations on the Isle of Sheppey and Swale.[308] Archaeological evaluation undertaken for this project has identified physical remains of the trenches constructed as part of the Land Front to survive around the study area, however these were found to be poorly preserved and their location to sometimes vary from that mapped during World War 1. The setting of these assets within the Stockbury Valley, their topographical location and their group value contributes to our understanding of the strategic and defensive role of these assets. Due to their value as evidence of World War 1 defensive structures, and their potential to contribute to the understanding of the defence of the region and inland stop lines during World War 1[309] (MKE40061, MKE99573, MKE98280 and ATK4), have been assessed to be of medium value.

Potential for unknown archaeological remains

11.7.23 Archaeological evaluation undertaken for this project has identified significant evidence of prehistoric activity to the northwest and southeast of the junction (ATK1 and ATK3) and has provided a good understanding of potential in these areas.

11.7.24 Whilst little or no archaeological evidence was identified to the northeast and southwest of the junction, evaluation in these areas did not reach natural strata due to the presence of thick overburden over 2 m in depth, which is likely to be associated with construction of the M2 and A249. Based on the results of evaluation to the northwest and southeast of the junction, and the identification of Iron Age bloomery activity at locations *c*.1 km and *c*.3 km to the west of the Scheme (OAN, 2018, 21), a high potential for the presence of unknown archaeological remains has been assessed for these areas. If associated with the remains identified at ATK1 and ATK3, any such remains have the potential to be of high value.

Historic Landscape

11.7.25 The KHER identified eight historic landscape types (HLTs) to be present within the study area. Their values are ascribed based on current understanding and professional judgement, assessed in line with the guidance in DMRB HA208/07, Table 7.1. These are presented in Table 11.5 below.

Table 11.5: Historic landscape baseline

Asset number	Asset name	Value	Description
HLT1.10	Medium regular fields with straight boundaries	Low	This type of field was typically created by 19th and 20th-century enclosure of downland and low lying areas. This type can also include

[308] WSP, 2017. M2 Junction 5 Improvements Scheme, Environmental Assessment Report, Appendix 7.1 Cultural Heritage Setting Assessment
[309] Smith, V. 2012. South East Research Framework Resource Assessment and Research Agenda for Defence Consultation draft October 2012, Defence since the application of gun powder: 1380-2000. Consulted at: https://www.kent.gov.uk/__data/assets/pdf_file/0004/55813/SERF-draft-paper-defence.pdf Accessed 04/12/18

Asset number	Asset name	Value	Description
	(parliamentary type enclosure)		enclosures whose boundaries have been straightened.
HLT 1.14	Irregular fields bounded by roads, tracks, and paths	Low	This type generally occurs on chalk uplands - especially the dip slopes and has resulted from post medieval informal enclosures. The roads and tracks are possibly old drove roads to and from the downlands. Other examples include extensive areas of 20th-century market gardening.
HLT 1.9	Small regular fields with straight boundaries (parliamentary type enclosure)	Low	These enclosures were typically formed by 19th and 20th-century enclosure. Some enclosures of this type may have resulted from straightening of wavy bounded fields.
HLT 3.1	Orchards	Low	Areas of commercially grown fruit trees.
HLT 4.9	Pre 19th century Coppices	Low	Coppice woodland planted after 1801. The dominant species is sweet chestnut. Variable in size and shape with straight or wavy boundaries.
HLT 9.2	Scattered settlement with paddocks (post 1800 extent)	Low	Scattered properties within a pattern of small rectilinear paddock or field enclosures.
HLT 9.6	Post 1810 settlement (general)	Low	Settlement which has developed since 1801. Includes expansion of hamlets, villages, towns and cities as well as new settlement groups.
HLT 11.2	Golf courses	Negligible	Golf courses are mostly 20th-century in date and are usually found near to settlements, especially towns, throughout the county.

11.7.26 A total of eight hedgerows depicted on the the maps for Stockbury, Borden and Newington-next-Sittingbourne have been identified to be present within the Scheme boundary. These hedgerows have been assessed to be important under the archaeology and history criteria of the Hedgerow Regulations (1997) as integral parts of a field system pre-dating the Inclosure Acts. Please refer to Chapter 7 Biodiversity and Appendix D.7 in Volume 2 for information on hedgerows identified to be significant under the wildlife and landscape criteria.

Previous archaeological investigations

11.7.27 A total of three previous archaeological investigations are recorded by the KHER within the study area.

11.7.28 An archaeological watching brief on construction of a riding school on Maidstone Road to the northeast of the study area in 2013 did not identify any archaeological remains (EKE12898).

11.7.29 A watching brief on construction of a water main undertaken in 2013 identified a Roman cremation with burial goods within the study area (MKE90925; EKE13175).

11.7.30 The third archaeological investigation recorded within the study area by the KHER comprises geophysical survey undertaken for this Scheme (see para 11.7.31 below).

Results from recent archaeological investigations

11.7.31 Archaeological investigation undertaken to inform the development of detailed design and mitigation proposals for this Scheme comprise:

- Geophysical survey of *c*.31 ha divided between 11 areas around Junction 5 undertaken in 2016[310] (presented in Appendix H.1 in Volume 2);
- Archaeological evaluation of the area around the junction comprising excavation of 71 trial trenches undertaken in 2017, providing a 5% sample of the 21.8 ha site[311] (Appendix H.1 in Volume 2);
- Additional geophysical survey of *c*.2 ha formed by a single land parcel to the northwest of Junction 5 to provide additional data on the prehistoric archaeology identified in this area[312] (presented in Appendix H.1 in Volume 2); and
- Additional Archaeological Evaluation was undertaken in December 2018 comprising two trenches that could not be excavated in 2017 in order to complete the 5% sample (Appendix H.2 in Volume 2).

11.7.32 The geophysical survey undertaken in 2016 identified several anomalies which were interpreted as trenches constructed during World War 1 as part of the Chatham Land Front. These features are recorded on the KHER as MKE98280. The survey results revealed magnetic disturbance throughout the survey areas which was thought to be of modern origin. A number of anomalies of uncertain origin were also identified, however were difficult to distinguish against the magnetic disturbance.

11.7.33 Trial trenching in the area between Maidstone Road and the A249 to the northeast of the junction revealed a thick layer of overburden to be present reaching over 2 m in depth which prevented natural strata being reached in this area. This is likely to be associated with the construction of the dual carriageway.

11.7.34 A thick layer of Made Ground over 2 m in depth was also identified in trenches to the southwest of the junction. Natural strata were encountered in the two northernmost trenches in this area due to their location further upslope, however no archaeological features were identified within these.

11.7.35 Evidence of Mesolithic activity comprising a relatively large flint assemblage was found in both to the northwest (ATK1) and southeast (ATK3) of the junction, and particularly within the eastern extents of ATK3 (Figure 11.1 in Volume 3). This evidence suggests exploitation of the Stockbury Valley as a routeway and hunting or resource gathering area, and it is possible that contemporary features may survive associated with these finds. The presence of both early and, more predominantly, late Mesolithic material may also indicate multiple phases of activity during the Mesolithic period. Large assemblages of this period are unusual in Kent and elsewhere in Britain are typically associated with sites

[310] GSB Prospection, 2016. Geophysical Survey Report G1615, M2 Junction 5 Improvements, Kent.
[311] Oxford Archaeology, 2018. M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report
[312] Sumo Survey. 2017. M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report.

overlooking watercourses and/or routeways along or between valleys. Mesolithic to Early Bronze Age domestic activity is typically only recognisable as ephemeral artefact scatters contained within top or plough soils with structural contexts being rare.

11.7.36 Evidence of Neolithic or Early Bronze Age activity was also identified in both ATK1 and ATK3. Although represented by a relatively small assemblage, this is typical for sites of this period.

11.7.37 Evidence of later prehistoric activity was represented by a few sherds of flint-tempered pottery of Late Bronze Age or Iron Age date, and a small flint assemblage in otherwise undated features, suggesting that scattered features of later prehistoric date may be encountered within the sites. As this activity does not appear to be associated with ritual monuments, it may be associated with domestic or other types of site.[313]

11.7.38 Also identified within ATK3 was a shaft, the fill of which included a high number of flints and a Mesolithic adze. The date and function of this feature is currently unclear. It is possible that it represents a mine or ritual shaft of Neolithic or Early Bronze Age, or a later shaft whose backfill has incorporated later surface material from immediate surroundings.[314]

11.7.39 From the Middle Bronze Age onwards, structured contexts including evidence for enclosures, houses, industrial features, field systems and larger landscape division become prevalent within the archaeological record; linked to increasing population, social complexity, growth in trading networks and establishment of hierarchies.

11.7.40 Evidence of smelting was identified in ATK1 and ATK3 with features including furnaces and pits. The slag recovered from these features reveals the use of two different types of furnace on these sites. Two different types of furnace were identified on these sites. These comprised shallow features characteristic of Iron Age technology where the slag was allowed to collect at the bottom of the furnace, and taller shaft furnaces where the slag was tapped off during the smelt, characteristic of Roman smelting techniques,[315] suggesting that the assets reveal the transition between technological traditions. Radiocarbon and pottery finds suggest this bloomery activity dates from the late Iron age or early Roman period, although there is some evidence to suggest that a later date, or possibly earlier date may also be possible. A high volume of metalworking debris was recovered from a limited number of features, suggesting that a much larger quantity of material may be present[316] and the presence of a substantial bloomery site.

11.7.41 Additional geophysical survey was undertaken to the northwest of the Scheme in 2017 to define the extent of ATK1.[317] This survey revealed bloomery activity to extend beyond the Scheme footprint, although the western edge of the asset appears to have been identified.

[313] Oxford Archaeology, 2018. M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report, page 21
[314] Oxford Archaeology, 2018. M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report, page 21
[315] Oxford Archaeology, 2018. M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report, page 20
[316] Oxford Archaeology, 2018. M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report, page 21
[317] Sumo Survey. 2017. M2 Junction 5 Improvements, Kent, Archaeological Evaluation Report

11.7.42 Although Iron Age bloomery sites are rare nationally, two similar sites have recently been excavated *c*.1 km and *c*.3 km from the Scheme, where both tapping and non-tapping furnaces were in use during the late Iron Age. This suggests that the North Downs may have been a significant centre for iron production during this period.

11.7.43 In consideration of the rarity of large Mesolithic assemblages within Kent, the potential that the late Neolithic/Bronze Age assemblage may be associated with a non-ritual site, and the rarity of smelting sites of Iron Age/Roman date at a national level, the value of ATK1 and ATK3 has been assessed to be high.

11.7.44 Evidence for the World War 1 Defences associated with the Chatham Land Front were identified at a number of locations during the evaluation (ATK4). In general, this evidence was poorly preserved and revealed some discrepancies with early 20th century mapping of the defences. In consideration of its survival and potential to contribute to our understanding of the Chatham Land Front and inland stop lines more generally, ATK4 has been assessed to be of high value.

11.7.45 The evaluation also identified two outlying undated features (ATK2 and ATK5). ATK2 comprises a pit which extended beyond the trench limits, the fill of which included frequent chalk and flint inclusions, and other discrete archaeological features which continued beyond the limits of the excavation. This asset has been assessed to be of low value. ATK5 comprises an undated ditch aligned northwest to southeast and has been assessed to be of negligible value.

11.7.46 The two additional trenches excavated in December 2018 identified no archaeological features pre-dating the modern period, although a number of Bronze Age flints were recovered unstratified from the spoil. A single linear feature on the mapped line of the World War I Chatham Lines was identified as being a backfilled defensive trench associated with these defences.

Future baseline

11.7.47 No changes to the current baseline are predicted prior to construction or operation of the Scheme.

11.8 Potential impacts

11.8.1 The type of impacts that can occur through a road improvement scheme include:

- Direct physical impacts, such as partial removal or total loss of a heritage asset or associated remains;
- Impacts on setting, which include non-physical changes to the character and significance of assets arising from works such as altering important lines of sight, removal of existing screening, and increasing air and noise pollution; and
- Indirect physical impacts such as alteration of water levels and de-watering of archaeological remains.

11.8.2 In accordance with the methodology outlined in Section 11.5 above, the assessment of direct impacts upon known remains will involve establishing the value of the affected heritage asset and the sensitivity of the asset to change. The impact magnitude is then calculated based on those factors.

11.8.3 To assist with understanding the timelines of any impacts likely to be caused by the Scheme, these have been separated into 'construction' (including any enabling works) and 'operation' impacts.

Construction

11.8.4 During construction, direct physical impacts are likely to occur from site vegetation clearance, earthmoving operations, creation of site compounds, road and bridge construction, and all associated infrastructures (gantries, signage, drainage etc.). Setting impacts are likely to occur due to the introduction of construction machinery on-site, temporary lighting, additional construction traffic, construction of compounds, and vegetation removal with the potential to create new sightlines and views of the Scheme.

11.8.5 The potential effects of construction activities upon setting would be temporary, short-term and reversible, however, physical impacts and new infrastructure are usually permanent in nature and therefore have a lasting effect.

11.8.6 Section 11.10 provides an assessment of the known heritage assets that are likely to be impacted by construction and operation of the Scheme.

11.8.7 The assessment for Road Drainage and the Water Environment (Chapter 8) for the Scheme concluded that based on current flood risk understanding and the correct implementation of all mitigation measures, there will be no significant adverse effects on groundwater or flood risk during construction or operation of the Scheme. It is therefore considered unlikely that changing water levels would result in harm to buried archaeological remains either within the Scheme boundary or the wider study area. Further assessment of harm due to flood risk has therefore been scoped out of their assessment.

Operation

11.8.8 During operation, the Scheme should have no additional physical impacts on buried archaeology, as any impacts will have been either designed out, leaving assets preserved *in situ*, or compensated through archaeological excavation and recording prior to construction. However, the setting of heritage assets could be impacted and these impacts could be short-term or permanent in nature. Measures will be developed therefore, at both the design stage and during and after construction to avoid any significant impacts, for example via appropriate screening, and where possible preserve or enhance the historic environment. Where impacts are unavoidable, careful design will seek to reduce such impacts to an acceptable minimum.

11.9 Design, mitigation and enhancement measures

11.9.1 In accordance with DMRB methodology, potential impacts on the historic environment are defined as changes to the historic environment resource caused by the mitigated Scheme. This assumes that any potential impacts are firstly avoided through careful design, such as preservation *in situ*. Where impacts are unavoidable, sensitive design will be employed to minimise as far as possible any remaining adverse impacts and strategies developed to ensure no additional significant effects are caused to the historic environment resource.

11.9.2 This chapter takes into account mitigation measures which have been incorporated into the design of the Scheme. The design of the Scheme has, where possible, placed new infrastructure within the line of the existing highways corridor and minimised the footprint required for construction, and been designed to avoid direct impacts on known heritage assets where possible.

11.9.3 An overall archaeological strategy will be developed for the Scheme in consultation with KCC Heritage Conservation Team. This strategy will identify the locations of and types of archaeological mitigation that will be applied based on the results of the evaluative works undertaken. The strategy will also identify areas where impact to significant archaeology will be, if possible, designed out.

11.9.4 Where archaeological assets will be impacted by the Scheme, these will be fully investigated and recorded in advance of construction. This follows current legislation, planning policy and guidance and best practice and requires that suitable measures and procedures will be developed in consultation with Historic England and the Local Planning Authority. Mitigation works required for known heritage assets within the Scheme boundary will include:

- Archaeological excavation undertaken in advance of construction: this is a programme of controlled, intrusive archaeological fieldwork undertaken within a framework of defined research objectives, to seek a better understanding of and compile a lasting record of the archaeological resource, and to analyse, interpret and disseminate the results (CIfA 2014a).[318] This will be undertaken in areas where relatively significant archaeological remains have been identified or are likely to be present (either through desk based assessment, geophysical survey, or archaeological trial trenching);
- Construction-integrated archaeological recording: this is a programme of observation, investigation and recording undertaken during construction. Under this form of investigation, the contractor's preferred method of working is determined by the need to undertake archaeological recording to the required standard (HS2, 2017)[319]. This would be undertaken in areas where it has not been practical or appropriate to undertake investigations in advance of construction, or where previous investigations have yielded inconclusive results but there is good potential for archaeological remains to be present; and
- Archaeological watching brief: a formal programme of archaeological observation and investigation undertaken during any operation carried out for non-archaeological reasons (CIfA 2014b).[320] This would be undertaken in areas of lower potential.

11.9.5 Direct physical impacts to potential unknown archaeological remains may occur during the construction of the Scheme. It is not possible to avoid these impacts by changes to the Scheme design. If unknown archaeological remains are identified during any works associated with the Scheme, appropriate procedures would be in place for the identification and treatment of such assets.

[318] CIfA, 2014b. Standard and guidance for archaeological excavation.
[319] HS2, 2017. Phase 2a Information Paper. E24: Archaeology.
[320] CIfA, 2014a. Standard and Guidance for an archaeological watching brief

11.9.6 These measures will inform the creation of individual Written Schemes of Investigation (WSIs) defining the methodologies for archaeological works, which will be produced in consultation with Kent County Council's Heritage Conservation Team and Historic England and updated as works progress as required by Paragraph 5.141 on the NN NPS.

11.9.7 All archaeological fieldwork undertaken ahead of, and during construction will be monitored by an appropriate specialist for Highways England to ensure that it is implemented appropriately and in accordance with the OEMP (see Appendix A in Volume 2).

11.9.8 Due to the nature of effects predicted on historic buildings and the historic landscape and the assessment of these effects as non-significant, no specific mitigation measures are predicted for these subtopics.

11.10 Assessment of effects

11.10.1 As identified in Section 11.8 above, in accordance with the requirements of DMRB, this assessment identifies the potential impacts of the mitigated Scheme on heritage. The mitigation measures set out in Section 11.9 would ensure that archaeological remains are either preserved *in situ* or, where this is not possible, that a formal record of the remains is created, archived and reported/published as appropriate.

11.10.2 Impact assessment tables setting out the predicted effects on heritage assets during construction and operation of the Scheme are provided in Appendix H.3 in Volume 2. A discussion of this assessment is provided below.

Construction

Significant effects

Non-designated assets

11.10.3 Construction of the Scheme would result in physical impacts on the non-designated multi-period sites of ATK1, located to the northwest of the Scheme and ATK3, located to the southeast of the Scheme. Due to their preservation of evidence for activity dating from the Mesolithic period to Iron Age, including a large flint assemblage of Mesolithic date and evidence of iron smelting during the Late Iron Age/Roman period, these assets have been assessed to be of high value.

11.10.4 The Scheme has been designed to reduce impact on ATK1 and ATK3 as far as possible. Land take for construction of the road from this area has been reduced as far as possible, and landscape mitigation has been designed to avoid tree planting and the use of deep-rooting species in this area. A physical impact on ATK1 and ATK3 would, however, occur as a result of the construction of the cutting for the northbound A249 sliproad, and the Oad Street link respectively. This would result in the removal of archaeological remains within the Scheme footprint in this area, however would largely avoid the areas which preserve evidence of smelting. In consideration of the extent of the assets which would be affected, after mitigation the magnitude of this impact has been assessed to be moderate adverse, resulting in a moderate adverse effect for both assets which is significant.

Non-significant effects

Scheduled Monuments and Listed Buildings

11.10.5 No impacts are predicted on Scheduled Monuments or Listed Buildings as a result of construction of the Scheme.

Non-designated assets

11.10.6 Construction of the Scheme would result in the removal of archaeological remains associated with ATK2, an undated pit, which has been assessed to be of low value. The magnitude of this impact has been assessed to be major, resulting in a slight adverse effect which is not significant.

11.10.7 Construction works would introduce intrusion into the panoramic views from the First World War battery south of Sittingbourne and Milton Golf Club, Stockbury (MKE99573) east and southeast, detracting from views from the battery along the stop line. Views from the asset to the south are already constrained by the presence of the M2 flyover. Whilst construction would increase intrusion in these views, key views north towards the Isle of Sheppey and the Swale would be maintained. The magnitude of this impact has been assessed to be minor adverse, resulting in a slight adverse effect which is not significant.

11.10.8 Archaeological evaluation undertaken for this Scheme has identified physical remains of the World War 1 Defences (ATK4) to survive within the study area, although their location sometimes varies from that recorded on the 1919 map of the Chatham Land Front held by Kent Record Office. Construction of the Scheme would result in the removal of any archaeological remains of the Stop Line present within the footprint of the Scheme. Noise and visual intrusion on the setting of the Stop Line would also result from construction activities. In consideration of the small extent of the asset that would be affected and the maintenance of views north and south along the stop line, the magnitude of this impact has been assessed to be minor adverse, resulting in a slight adverse effect which is not significant.

11.10.9 Construction of the Scheme would result in temporary impacts on the setting of Vale House (MKE85122). The presence of the existing dual carriageway forms a prominent element within the asset's current setting and results in noticeable noise intrusion on its setting. During construction, the presence of the construction zone directly to the north of the asset's boundary wall would result in increased noise and visual intrusion as a result of construction activities and the presence of the construction site, further detracting from the rural character of its setting. The magnitude of this impact has been assessed to be minor adverse, resulting in a slight adverse effect which is not significant.

11.10.10 Impacts on the setting of the First World War Pillbox, Stockbury (MKE40061) would also result from construction of the Scheme. Located *c*.40 m to the northwest of the Scheme, construction works would form a temporary intrusive element in the setting of the asset, introduce intrusion into views north and south along the Stockbury Valley, and detract from understanding of its historic function controlling movement along the Maidstone Road as part of the Chatham Stop line. The relationship of the pillbox with other surviving elements of the Stop Line would not be impacted. The magnitude of this impact has been assessed to be minor adverse, resulting in a slight adverse effect which is not significant.

11.10.11 Construction of the Scheme would require land take for construction of the realigned road, slip roads, and associated embankments and cuttings, resulting in some limited removal of field boundaries and localised loss of historic landscape character for the following HLTs:

- HLT1.14 – fields predominantly bounded by tracks, roads and other rights of way;
- HLT1.1 – medium regular fields with straight boundaries (parliamentary type enclosures); and
- HLT9.2 – scattered settlements with paddocks (post 1800 extent).

11.10.12 This would result in a limited impact on the historic landscape character of these types. The magnitude of impact on these low value HLTs has been assessed to be minor adverse, resulting in a slight adverse effect which is not significant.

11.10.13 Land take from HLT11.2, Golf courses, would also be required for construction of the Scheme. This would affect a small area of this HLT along the existing highways corridor and would not affect the legibility of this type. The magnitude of impact on this HLT of negligible value has been assessed to be negligible resulting in a neutral effect which is not significant.

11.10.14 A total of eight hedgerows assessed to be significant under the Archaeology and History criteria of the Hedgerow Regulations would be removed by construction of the Scheme. Of these, one would be translocated due to its significance under the wildlife and landscape criteria (refer to Chapter 7 Biodiversity and Appendix D.7 in Volume 2 for further information).

Unknown archaeological remains

11.10.15 High potential for unknown archaeological remains to be present to the northeast and southwest of the Scheme has been identified during the archaeological evaluations (see 11.6.30 to 11.6.31 above). Although a good understanding of what archaeological remains are likely to be present is given by these evaluations, they cannot be guaranteed to be 100% accurate as to the exact nature of the archaeological resource. Depending on the depth and nature of construction works in these areas, construction has the potential to remove unknown archaeological remains within the Scheme footprint. As the extent or value of any such remains is unknown, the significance of this effect cannot currently be assessed and remains unknown. These areas will be subject to construction-integrated archaeological recording during construction of the Scheme, to enable any archaeological remains revealed by the works to be fully recorded.

Operation

Significant effects

11.10.16 All effects on buried archaeology will be restricted to the construction phase.

11.10.17 No significant effects from changes within the setting of designated or non-designated archaeological remains, historic buildings or the historic landscape have been identified. No significant effects on heritage assets are therefore predicted during operation of the Scheme.

Non-significant effects

Non-designated assets

11.10.18 Operation of the Scheme would result in impacts on the setting of Vale House (MKE85122); the First World War Pillbox, Stockbury (MKE40061); the First World War battery south of Sittingbourne and Milton Golf Club, Stockbury (MKE99573); and the World War 1 Defences (ATK4) due to the presence of the dual carriageway running on to embankment to the north, the new roundabout junction, slip roads and local access road. Whilst the existing dual carriageway forms an element in the assets' setting, these new elements would increase the prominence of highways infrastructure within this setting.

11.10.19 Due to the prominence of the new junction in views from the pillbox, battery and trench network along the Stockbury Valley; a key attribute of the assets' original function and design, the magnitude of this impact has been assessed to be minor adverse for the First World War Pillbox, Stockbury (MKE40061), First World War battery south of Sittingbourne and Milton Golf Club, Stockbury (MKE99573) and the World War 1 Defences (ATK4). The effect has been assessed to be slight adverse, not significant, for all three assets.

11.10.20 The historic relationship of Vale House to the rural landscape would continue to be legible. The magnitude of impact on Vale House (MKE85122) has therefore been assessed to be negligible, resulting in a neutral effect which is not significant.

11.10.21 Impacts on the historic landscape would continue from the construction phase during operation of the Scheme. The presence of the upgraded junction, slip roads, link road and associated cuttings and embankments would increase the prominence of highways infrastructure within the four affected HLTs, however these impacts would be focussed along the existing highways corridor and would result in a limited impact on their historic landscape character. The magnitude of impact has been assessed to be minor and the effect assessed to be slight, not significant, for the following three HLTs:

- HLT1.1 – medium regular fields with straight boundaries (parliamentary type enclosures);
- HLT1.14 – fields predominantly bounded by tracks, roads and other rights of way; and
- HLT9.2 – scattered settlements with paddocks (post 1800 extent).

11.10.22 A negligible magnitude of impact resulting in a neutral effect which is not significant, has been assessed for HLT11.2, Golf courses, as its legibility would not be affected by the presence and operation of the Scheme.

11.10.23 No effects are predicted on the remaining non-designated heritage assets during operation of the Scheme. The Scheme will not result in a change within their settings of a magnitude that will affect their significance.

11.10.24 All effects on buried archaeological remains will be limited to the construction phase. No effects are predicted on unknown archaeological remains from operation of the Scheme.

Residual effects

11.10.25 Residual effects are summarised in Table 11.6 below.

Table 11.6: Summary of residual effects

Predicted effect	Mitigation	Residual effect
Construction phase		
Direct physical effects on Assets ATK1 and ATK3	The detailed design has been developed to avoid known remains. Archaeological excavation in advance of construction to ensure adequate investigation and recording of remains in footprint of Scheme.	Moderate adverse
Direct physical effects on unknown buried remains	Construction-integrated archaeological recording to the northeast and southwest of the Scheme.	Unknown
Direct physical effects on historic landscape	No mitigation proposed as effects assessed to be non-significant.	Slight adverse
Direct effects on setting	None proposed as effects on setting are temporary and will be limited to the construction period.	Slight adverse
Indirect effects on heritage assets	None proposed as effects assessed to be non-significant.	None
Operational phase		
Direct effects on setting	Measures embedded in Scheme design and Environmental Master Plan including tree and shrub planting to aid integration of the Scheme into the surrounding landscape.	Slight adverse
Indirect effects on heritage assets	None proposed.	None

11.10.26 Construction of the Scheme would result in the partial removal of archaeological remains associated with the multi-period archaeological sites of Assets ATK1 and ATK3, both of which have been assessed to be of high value. Whilst a programme of archaeological works to record these assets will be undertaken prior to construction of the Scheme, this cannot completely mitigate the adverse impact resulting from the permanent loss of archaeological evidence. The residual significance of effect has therefore been assessed to remain moderate adverse for both assets.

11.10.27 Although construction of the Scheme would result in the partial removal of these high value assets, the area of impact is limited and would largely avoid the areas which preserve evidence of Romano-British smelting. The Scheme would therefore not reduce the overall significance of the assets.

11.11 Cumulative effects

11.11.1 As shown on Figure 15.1 in Volume 3, there are two known potential cumulative developments within 1.5 km of the Scheme. The Land at Woodgate Lane and

Builder's Yard developments both comprise redevelopment of existing brownfield land for residential use.

11.11.2 Two further potential cumulative developments lie within 3km of the Scheme. The Land at Wises Lane development comprises a hybrid application for up to 595 dwellings, a primary school, retail, sports pitches, a link road, allotments and landscape and ecological enhancement works. The Manor Farm development comprises an outline application for up to 50 dwellings.

Designated heritage assets

11.11.3 No impacts on designated heritage assets or their settings are predicted as a result of this Scheme. Consequently, no cumulative effects on designated heritage assets are predicted.

Non-designated heritage assets

11.11.4 No impacts are predicted on known heritage assets as a result of the Land at Woodgate Lane and Builder's Yard developments. The former farmsteads identified at MKE8152 and MKE8153 are located *c*.130 m and *c*.185 m of these sites and comprise discrete sites which would not be physically impacted by the proposed developments. The legibility and understanding of the milestone (MKE78194) located *c*.60 m north of the Land at Woodgate Lane site would not be impacted by redevelopment of brownfield land. No cumulative effects on non-designated heritage assets are therefore predicted.

Unknown archaeological remains

11.11.5 The potential for unknown archaeological remains to be present within the study area has been identified. The proposed developments at Land at Woodgate Lane and Builder's Yard are both located on brownfield land. Previous development of these sites is likely to have truncated or removed unknown archaeological remains within these sites. Based on currently available information, it is considered unlikely that impacts on archaeological remains would result from the proposed developments. No cumulative impacts are therefore predicted on unknown archaeological remains.

11.12 Monitoring

11.12.1 All archaeological fieldwork undertaken ahead of, and during construction will be monitored by an appropriate specialist from Highways England to ensure that it is implemented appropriately and in accordance with the OEMP (see Appendix A in Volume 2).

11.13 Summary

11.13.1 Analysis undertaken for this assessment has identified the Scheme to be located in an area which preserves archaeological remains dating from the Mesolithic period to the 20th century. This assessment has identified the potential for encountering both known and unknown heritage of these dates during construction works required for the Scheme. Historic buildings identified within the baseline date from the medieval period to 20th century, comprising a parish church, post-medieval farmhouse and World War 1 pillbox. The historic

landscape of the study area is characterised principally by agricultural types dating from the post-medieval period.

11.13.2 Measures to avoid or reduce effects on heritage assets have been incorporated during development of the Scheme design.

11.13.3 After mitigation, significant adverse effects during the construction phase have been identified on two multi-period archaeological sites which have been assessed to be of high value (ATK1 and ATK3). Although construction of the Scheme would result in the partial removal of these high value assets, the area of impact is limited and would largely avoid the areas which preserve evidence of Romano-British smelting. The Scheme would therefore not reduce the overall significance of the assets.

11.13.4 After mitigation, a non-significant effect has been identified on World War 1 Defences (ATK4) associated with the Chatham Land Front due to the removal of associated archaeological remains, where these are present within the Scheme footprint.

11.13.5 A non-significant effect has been identified at one further archaeological asset (ATK2).

11.13.6 In accordance with national and local planning policy, an archaeological mitigation strategy is proposed which would be developed in consultation with relevant stakeholders. This would be informed by the results of recent archaeological investigations and would include archaeological excavation, construction-integrated archaeological recording and watching briefs.

11.13.7 The mitigation outlined above would ensure preservation either *in situ* or by record of the known heritage assets impacted by construction of the Scheme and would enable identification and preservation by record of any hitherto unrecorded archaeological remains.

11.13.8 Effects on the setting of a non-designated First World War Pillbox (MKE40061), a First World War battery site (MKE99573) and the World War 1 Trench network have been identified during construction and operation of the Scheme. These effects have been assessed as not significant for all three assets.

11.13.9 The Scheme will largely be focussed along the base of the Stockbury Valley, close to the existing dual carriageway, with realignment of the carriageway, the addition of slip roads and improvement of the roundabout junction. These changes would result in limited effects on the historic landscape character of the study area.

11.13.10 No cumulative effects on heritage assets have been identified as a result of the Scheme.

12. Materials and Waste

12.1 Introduction

12.1.1 This chapter assesses the impacts of material assets and waste associated with the Scheme during its construction, demolition and excavation (CD&E) phases. This chapter has been written in accordance with IAN 153/11 and Highways England Guidance.

12.1.2 The operational phase of the Scheme was scoped out of this assessment at the scoping stage which is outlined in Section 12.8 below.

12.1.3 Material assets are defined as per the IAN 153/11: Guidance on the Environmental Assessment of Material assets IAN 153/11 as “the materials and construction products required for the construction, improvement and maintenance of the trunk road network. Material assets include primary raw materials such as aggregates and minerals, and manufactured construction products. Many material assets will originate off-site, purchased as construction products, and some will arise on-site such as excavated soils or recycled road planings.”

12.1.4 Waste is defined as per the Waste Framework Directive (2008/98/EC) as “any substance or object which the holder discards or intends or is required to discard."

12.1.5 The assessment of effects arising from materials assets and waste generation includes the use of materials and the generation/management of waste.

12.2 Competent expert evidence

12.2.1 This Materials and Waste chapter has been undertaken by the following individuals who have used their knowledge and professional judgement to undertake this assessment:

- Liz Gray who is a chartered Environmentalist and holds full professional membership with the Institute of Environmental Management and Assessment. Liz has 15 years of knowledge and experience in materials and waste assessment. Liz has a BSc in Biology, a MSc in Environmental Diagnostics and is a Qualified Person under CL:AIRE DoWCoP.
- Alexandra Evans who is a chartered Waste Manager and holds full professional membership with the Chartered Institute of Waste Management. Alexandra has 12 years of knowledge and experience in materials and waste assessment. Alex has a BSc in Environmental Science.
- Luke Harrison who is working towards his practitioner membership with the Institute of Environmental Management and Assessment. Luke has three years of knowledge and experience in materials and waste assessment.

Luke has a BSc in Environmental Science and is Level 4 WAMITAB qualified for anaerobic digestion.

12.3 Legislative and policy framework

12.3.1 A summary of legislative requirements in relation to material assets and waste and how they apply to the Scheme is presented in Table 12.1 below.

12.3.2 Many of the relevant UK acts and regulations relating to waste incorporate European Union (EU) directives into UK Law. These include:

- EU Revised Waste Framework Directive (2008/98/EC);
- EU Landfill Directive (1993/31/EC), as amended by the EU Directive (2003/33/EC);
- EU Regulation 1272/2008 on classification, labelling and packaging of substances and mixtures (including revisions); and
- EU Directive 91/689/EEC on hazardous waste.

Table 12.1: Legislation, regulatory and policy framework for materials and waste

Scale	Legislation/ regulation	Summary of requirements
National	National Planning Policy Framework (NPPF) 2019	As part of the 2019 revision, the National Planning Policy Frameworks (NPPF) goal of supporting sustainable development identifies the importance of using natural resources prudently and minimising waste. It identifies that strategic policies should make provision for minerals and waste management. Section 17 focuses on “Facilitating the sustainable use of minerals”, and states planning policies should include consideration of the following points: • provide for the extraction of mineral resources of local and national importance, except for peat; • take account of the contribution that recycled materials and minerals waste can make to supply; and • safeguard mineral resources by defining Mineral Safeguarding Areas.
	National Networks National Policy Statement (NN NPS)	The National Networks National Policy Statement outlines that Government policy on hazardous and non-hazardous waste is intended to protect human health and the environment by producing less waste and by using it as a resource wherever possible. Where this is not possible, waste management regulation ensures that waste is disposed of in a way that is least damaging to the environment and to human health. The ‘applicant’, in this case Highways England, should set out the arrangements that are proposed for managing any waste produced. The arrangements described should include information on the proposed waste recovery and disposal system for all waste generated by the development. Highways England should also seek to minimise the volume of waste produced and the volume of waste sent for disposal unless it can be demonstrated that the alternative is the best overall environmental outcome.

Scale	Legislation/ regulation	Summary of requirements
		Management measures are inclusive of but not limited to, the implementation of the waste hierarchy (see Figure 12.1 below), the correct management of waste both on-site and off-site and identifying the appropriate waste infrastructure for waste treatment and disposal.
	The Environmental Protection Act 1990 (c.43) as amended in 1996 and 1999	The Environmental Protection Act 1990 (c. 43) as amended in 1996 and 1999 implements integrated pollution control for the disposal of waste to air, land and water, including solid waste disposal. The Environmental Protection Act 1990 (c. 43) as amended in 1996 and 1999 implements integrated pollution control for the disposal of waste to air, land and water, including solid waste disposal. As part of this, under Section 34, the Act imposes Duty of Care on anyone who produces, imports, keeps, stores, transports, treats or disposes of waste. This will mean that Highways England and all contractors must take all reasonably practical steps to ensure that: • Waste is consigned only to a registered waste carrier, licensed waste contractor, local authority waste collector or person dealing with waste in ways that are exempt from licensing; • Waste that is disposed of is accompanied by a detailed written description of the waste to ensure its safe handling, treatment and disposal (waste transfer notes are to be kept for a minimum of two years and hazardous waste consignment notes are to be kept for a minimum of three years); • Waste is securely contained to prevent it escaping to the environment; • Appropriate measures are taken to ensure that others involved in the handling and disposal of waste do so in accordance with the all applicable Regulations; • Copies of registration certificates should be obtained for all waste contractors and waste carriers used as part of the Scheme and it should be ensured that they are on the Environment Agency's 'Public Register of Waste Carriers, Brokers and Dealers'; and • Checks should be made on the final destination of each waste, ensuring that each waste disposal facility is licensed to accept the waste. Duty of Care audits of carriers and waste disposal facilities are advisable. The generation of waste from the Scheme shall be managed in accordance with all applicable legislation and policy and in accordance with good practice.
	Clean Neighbourhoods and Environment Act 2005 (c. 16)	Chapter 16 of the Clean Neighbourhoods and Environment Act 2005 (c. 16) prescribes the correct transportation, collection, disposal and management of waste and prohibits fly tipping.
	Waste (England and Wales) Regulations	The Regulations 2011 (SI 2011/988), as amended in 2012 (SI 2012/1889) and in 2014 (SI 2014/656), transpose the Revised EU Waste Framework Directive (2008/98/EC) into English law and require organisations to manage waste in

Scale	Legislation/ regulation	Summary of requirements
	2011 (SI 2011/988)	alignment with the waste hierarchy, to prevent waste going to landfill. Waste management contractors working on the Scheme will be required to provide evidence that the waste hierarchy has been applied. This evidence can be in the form of waste transfer notes and hazardous waste consignment notes, which themselves must be kept for two and three years, respectively.
	The Hazardous Waste (England and Wales) Regulations 2005 (SI 2005/894)	The Regulations, as amended in 2009 (SI 2009/507), 2015 (SI 2015/1360) and 2016 (SI 2016/336) applies to all wastes listed as hazardous in the European Waste Catalogue (2000/532/EC) and the CLP (Classification, Labelling and Packaging) Regulation (EC 1272/2008). Hazardous waste will be produced throughout all lifecycle stages of the Scheme. Hazardous waste should be disposed of in accordance with the Regulations. including a hazardous waste consignment note.
	Waste Electrical and Electronic Equipment (WEEE) Regulations 2013 (SI 2013/3113)	The Regulations have a key objective to reduce the amount of WEEE that goes to landfill. This is to be achieved by making producers responsible for the collection, treatment and recovery of WEEE, including the associated costs. For the Scheme, all WEEE produced in the CD&E and operational phases must be segregated and managed separately from other wastes, with relevant paperwork provided as described above.
	The Waste Batteries and Accumulators Regulations 2009 (SI 2009/890)	The Regulations main requirements are that producers of batteries and accumulators must either take back waste batteries and accumulators or fund the collection and recycling of them. The 2015 amendment removed several additional requirements, inclusive of the provision of operational plans and independent audit reports. For the Scheme being considered, all batteries produced in the CD&E and operational phases must be segregated and managed separately from other wastes.
	The CLP (Classification, Labelling and Packaging) Regulation (EC 1272/2008)	The CLP Regulation, has replaced the Dangerous Substances Directive (67/548/EEC) and the Dangerous Preparations Directive (1999/45/EC). To summarise, the Regulation provides guidance on the application of the CLP criteria for hazards (physical, health and environmental). With specific reference to the Scheme, the Regulation should be used to support the classification of both waste and materials. All waste should be classified by a six-digit code, which must be recorded on all waste transfer notes and hazardous waste consignment notes for the movement of waste from the CD&E and operational phases of the Scheme.
	Environmental Protection (Disposal of Polychlorinated Biphenyls and other Dangerous Substances) (England and	The Regulations, as amended in 2000 (SI 2000/3359), require the safe disposal or decontamination of all equipment that contains polychlorinated biphenyls (PCBs). Contaminated equipment containing over 5 litres or more of PCB substance or mixture is also covered by the Regulations. PCBs are often present in areas of historical industrial use.

Scale	Legislation/ regulation	Summary of requirements
	Wales) Regulations 2000 (SI 2000/1043)	
	The Environmental Permitting (England and Wales) Regulations 2016 (SI 2016/1154)	The Environmental Permitting Regulations 2016 put in place requirements to ensure that sites that produce certain materials and undertake certain activities (such as the storage, use or treatment of waste) have a permit or exemption from the regulator (i.e. the Environment Agency). Permit or exemption details of all sites that manage waste from the Scheme will be checked to ensure waste is being managed legally.
	Environmental Damage (Prevention and Remediation) Regulations 2009 (SI 2009/153)	The Regulations, as amended in 2010 (SI 2010/587), introduce obligations to ensure the polluter pays for any environmental damage caused. The Regulations are applicable to all economic activities and therefore cover businesses. The Regulations require caution to be taken when managing sites to prevent damage to water, land and biodiversity. Such damage could be caused by poor waste management practices and as such the generation of waste from the Scheme must be managed in accordance with all applicable legislation and policies and in accordance with good practice.
	The Control of Asbestos Regulations 2012 (SI 2012/632)	The Regulations require notification to the appropriate authority of all notifiable asbestos works (as specified in the Regulations), the medical surveillance (from April 2015) and health records for employers dealing with asbestos, the provision of the correct equipment and training for working with asbestos; and the documentation of the method, storage and disposal of asbestos waste. Any waste containing asbestos (e.g. insulation or lagging) must be stored and disposed of, in suitable packaging to prevent fibre release, in line with the Regulations. All asbestos must be removed by a licensed contractor who has undergone the appropriate training for the removal of asbestos and must wear the appropriate Personal Protective Equipment (PPE). Written records must be kept of the workers and the likely level of exposure. The asbestos must only be disposed of at an appropriately permitted disposal site. These regulations will be adhered to during the construction of the Scheme to minimise harm to human health due to asbestos exposure.
	Waste Management Plan for England 2013	This plan provides an overview of waste management in England and fulfils the revised WFD Article 28 mandatory requirements, and other required content as set out in Schedule 1 to the Waste (England and Wales) Regulations 2011. DEFRA drew on issues from the previous Waste Strategy for England (WS2000), the Waste Strategy for England (WS2007), European Directives and Legislation to create the Waste Management Plan for England 2013. The Plan continues to focus on the importance of driving waste management up the waste hierarchy and states the importance of considering the Government's ambition of achieving a zero waste economy. The Plan puts a strong emphasis on waste prevention through making products

Scale	Legislation/ regulation	Summary of requirements
		using fewer natural resources. The targets outlined in WS2007 remain relevant, including the target to recover 70% of construction and demolition waste by 2020. This target shall be considered a minimum requirement the Scheme.
	National Planning Policy for Waste 2014	The National Planning Policy for Waste is the formal replacement for Planning Policy Statement 10 (PPS10). It follows the principles set out in PPS10, which states that waste should be managed in line with the principles of the waste hierarchy. It is important to ensure that, where possible, waste production is minimised to reduce environmental impacts and to ensure an assessment is made of the local waste infrastructure type and capacities, to include, but not be limited to, an assessment of the local policies.
	Waste Planning Practice Guidance 2015	The Planning Practice Guidance website details how to adhere to the National Planning Policy for Waste 2014. The guidance should be followed to satisfy the local planning authority that impacts introduced by a proposed development on the existing waste management facilities are acceptable and do not prejudice the implementation of the waste hierarchy (see Figure 12.1 below).
	Road Investment Strategy (RIS) and Strategic Business Plan 2015	The RIS does not refer to waste directly, however the strategy highlights Highways England's commitment to improving and sustaining the environment. Waste management plays a role in environmental sustainability.
Regional	The Kent Minerals and Waste Local Plan 2013-30	The Kent Minerals and Waste Local Plan 2013-30 (KMWLP) sets out the vision and strategy for mineral provision and waste management in Kent to the year 2030. It contains several minerals and waste development management policies for evaluating planning applications and considers strategic site provisions.

Table Source: Various

12.4 Study area

12.4.1 Two study areas have been defined for the assessment as per Highways England guidance. These are:

- The Scheme boundary to cover mineral safeguarding areas, peat resources and the re-use of waste. Within this area, material assets will be consumed (used, re-used and recycled) and waste will be generated; and
- The area for the supply of material assets and management of waste.

12.4.2 This second area is open to professional judgement on a project by project basis. As such, on this project the study area for the supply of material assets will be the South East region of England and the study area for waste infrastructure capacity will be the county of Kent.

12.5 Assessment methodology

Level and scope of assessment

12.5.1 The methodology and criteria described below form a detailed assessment in accordance with IAN 153/11 (2011) and Highways England guidance. This has been applied to determine the significance of effects associated with material assets and waste during the construction phase of the Scheme.

12.5.2 The following tasks were undertaken to determine the impact of material assets and waste from the Scheme:

- Review of relevant waste legislation, national, regional and local planning policies and guidance;
- Review of proposed construction materials and quantities;
- Estimate the quantities and types of wastes to be generated during CD&E;
- Identify and evaluate the impacts of the Scheme against the baselines identified in Section 12.7;
- Identify opportunities to replace virgin/raw materials with recycled materials/materials with recycled content and maximise the use of renewable material assets over the use of non-renewable material assets wherever feasible; and
- Identify opportunities to reduce, re-use, recover and/or recycle materials and wastes via a review of the proposed development (including proposed building materials, construction methods and design, where available) and in accordance with industry best practice.

Assessment methodology

12.5.3 The methodology and criteria described in Highways England guidance has been applied during the EIA to determine the significance of effects associated with material assets and wastes during the construction phase of the Scheme.

12.5.4 The magnitude of the anticipated material assets used, and waste generated by the Scheme, has been determined by assessing the Bill of Quantities and the emerging design detail.

12.5.5 The results of the assessment have been tabulated and presented in Section 12.10. Additional detail (including a breakdown of waste types) will be provided in the Site Waste Management Plan (SWMP) by the contractor.

Assessment Criteria

12.5.6 The impact of the Scheme on material assets and waste has been calculated by establishing the significance of the impact; this was achieved by assessing the level of environmental effect. Table 12.2 below summarises how the effects were defined.

Table 12.2: Criteria for classifying the environmental effects

Significance category	Description
Neutral	Material Assets • No reduction or alteration in the availability of material assets at a regional scale (relating to the resources the project has used). Waste • No reduction or alteration in the capacity of waste infrastructure at a regional scale.
Slight	Material Assets • Requires ≤50% of primary materials to be sourced nationally (with other primary materials sourced at a lower geographic scale); and • Comprises re-used/recycled aggregate (alternative materials) above the higher of the relevant regional or national percentage target (South East England target: 26% and England's target: 25%). Waste • ≤1% reduction or alteration in the regional capacity of waste infrastructure; and • Waste infrastructure has sufficient capacity to accommodate waste from a project, without compromising integrity of the receiving infrastructure (design life or capacity) within the region.
Moderate	Material Assets • >50% of primary materials to be sourced nationally (with other primary materials sourced at a lower geographic scale); and • Comprises re-used/recycled aggregate (alternative materials) below the lower of the relevant regional or national percentage target (South East England target: 26% and England's target: 25%). Waste • >1% reduction or alteration in the regional capacity of waste infrastructure as a result of accommodating waste from a project; and • 1-50% of project waste requires disposal outside of the region.
Large	Material Assets • >50% of primary materials to be sourced internationally; • Sterilises ≥1 mineral safeguarding site and/or peat resource; and • Comprises no re-used/recycled aggregate (alternative materials). Waste • >1% reduction or alteration in the regional capacity of waste infrastructure as a result of accommodating waste from a project; and • >50% of project waste requires disposal outside of the region.
Very large	Material Assets • No criteria: use criteria for large category Waste • >1% reduction or alteration in national capacity of waste infrastructure, as a result of accommodating waste from a project; or • The project would require new (permanent) waste infrastructure to be constructed to accommodate waste.

Table Source: Highways England guidance

12.5.7 Table 12.2 defines 'neutral' to 'very large' environmental effects which combine to determine the Scheme's significance level as shown in Table 12.3 below. Any effects can then be defined as significant or not significant.

Table 12.3: Significance criteria for material assets and waste

Significance	Description
Not significant	Material Assets: Category description met for neutral, slight or moderate effect. Waste: Category description met for neutral or slight effect.
Significant (one or more criteria met)	Material Assets: Category description met for large effect. Waste: Category description met for moderate, large or very large effect.

Table Source: Highways England guidance

12.6 Assumptions and limitations

Assumptions

- It has been assumed that material assets' use and waste generation will be spread equally across the construction period (approximately 18 months) as there are several stages of construction within the entire construction phase. Therefore, it's not expected that all excavation waste will be produced at the same stage. Demolition and excavations will likely occur at the beginning of each construction stage and stockpiled before removal from site or re-use;
- All material quantities have been converted into tonnes using industry standard conversion rates;
- All material assets have been grouped according to main material types, as shown in 12.7; and
- Wastage rates, published by the Construction Resources and Waste Platform, have been applied to all material resource tonnages to determine the likely waste arisings (offcuts, damaged and surplus materials).

Limitations

12.6.1 It has not been possible at this stage to source detailed construction compound information or details of the gatehouse to be demolished. Therefore, estimates have been used and are included as part of the assessment.

12.6.2 It has not been possible to quantify the amount of asbestos found within the Scheme boundary. Sheet asbestos was found in one location in archaeological trench 77, where the Maidstone Road link is due to be constructed.

12.6.3 Asbestos waste is classified as hazardous waste and any other inert/non-hazardous wastes (such as soil arisings) mixed with asbestos fibres are likely to be hazardous. Therefore, there is a potential for hazardous waste to be generated by the Scheme. A further ground investigation will be undertaken at

detailed design stage which will delineate this area to address any remediation/disposal. As this area cannot be quantified at this stage it has not been included in this assessment.

12.6.4 The current ground investigation data available is minimal, which has limited the design team's ability to determine if any of the site won material (cut) will be suitable for reprocessing/treatment and re-use. Therefore, a worst-case assessment has been carried out assuming no excavated waste is re-used on-site. It should be noted that suitability for re-use is primarily constrained by geo-technical suitability rather than chemical suitability, as no major historical contaminated land uses have been identified in the area. The ground investigation due to be carried out should inform possibilities for re-use at the detailed design stage.

12.7 Baseline conditions

12.7.1 Desk based information was gathered from the sources listed below to identify the existing aspects impacted by the Scheme's use of material assets and generation of waste:

- Material assets – Mineral Products Association;
- Mineral safeguarding – Kent County Council; and

12.7.2 Waste – Kent County Council.

12.7.3 The baseline for material assets and waste are presented below.

Material assets baseline

12.7.4 The South East of England regional baseline was selected in line with Highways England guidance. However, it should be noted that there is no guarantee that materials will be sourced from the South East as final materials selection will be determined by the contractor. The baseline data was sourced from the Mineral Products Association Profile of the UK Mineral Products Industry Report 2018 (the most recent publicly available data) showing the annual sales data for mineral products in the UK.

12.7.5 The construction materials detailed in Table 12.4 are based on the main construction materials identified from previous road improvement schemes.

12.7.6 Note, given that the number, type and size of construction developments varies from year to year, the demands for construction materials will also fluctuate. As such, this data should be considered representative.

Table 12.4: Regional material assets baseline

Construction material	South East regional baseline 2018
	Tonnes per annum
Aggregate	13,000,000*
Ready Mix Concrete	6,025,000**
Asphalt	1,600,000
*Combines crushed rock, sand and gravel figures.	

Construction material	South East regional baseline 2018
	Tonnes per annum
**Converted from m^3 using a 1 m^3 to 2.41 tonnes. Conversion Source: https://www.traditionaloven.com/building/masonry/concrete/convert-cubic-metre-m3-concrete-to-tonne-metric-t-concrete.html.	

Waste infrastructure baseline

12.7.7 CD&E waste generated by the Scheme during construction is predominantly non-hazardous and inert, with small quantities of hazardous waste (e.g. associated with sealants, paints, solvents and contaminated soil).

12.7.8 The amount of CD&E and hazardous waste capacity in the study area will fluctuate year on year based on the number, type and size of construction projects underway. This in turn is heavily influenced by factors such as the economic situation, investment levels and legislative and policy variations.

12.7.9 The baseline for inert/non-hazardous CD&E waste infrastructure capacity for Kent was calculated using the 2015 baseline profile detailed in the Kent Waste Needs Assessment 2017.

12.7.10 The baseline for hazardous waste was taken from the Kent Hazardous Waste Needs Assessment 2017.

12.7.11 These capacities are presented in Table 12.5.

Table 12.5: Waste infrastructure baseline

Waste stream	Tonnes per annum
CD&E	5,983,247*
Hazardous	158,922**
*Sum of all CD&E capacities. Deposit to land capacity has been averaged over the 14 years of the KMWLP to provide a per annum capacity. A soil conversion factor of 1 m^3/ 1.25 tonnes was applied to calculate the annual tonnage for deposit to land. Composting capacity was set to a zero value at it is predicted there will be capacity deficit. ** Hazardous figures include, merchant landfill, restricted landfill, metal recycling, material recycling facility, physical treatment and physical-chemical treatment facility capacities.	

Mineral Safeguarding Areas

12.7.12 Kent Mineral Safeguarding Area Maps[321] showed that the Scheme does not pass through any Mineral Safeguarding Areas.

Peat reserves

12.7.13 Sources[322][323][324] showed there are no Blanket Bogs, Lowland Fens or Lowland Raised Bogs within the Scheme boundary. Therefore, there are no areas that are/could give rise to peat reserves within the Scheme line boundary.

[321] http://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/planning-policies/minerals-and-waste-planning-policy#tab-1
[322] http://magic.defra.gov.uk/
[323] http://www.landis.org.uk/soilscapes/
[324] http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Future baseline

12.7.14 There is no up to date available information on any changes to waste infrastructure capacity or material resource capacity prior to construction or operation of the Scheme. The availability of resource fluctuates naturally year on year depending on the number of construction developments on going in the region. No large scale committed developments have been identified that would significantly change the baseline prior to construction or operation.

12.8 Potential impacts

12.8.1 During construction, the Scheme would likely impact the material assets market and waste infrastructure capacity.

12.8.2 The impact on the material assets markets within the study area would be due to the use of materials as part of construction. Materials likely to be used are aggregates, asphalt and concrete with smaller quantities of metals and wood.

12.8.3 The impact on the total waste infrastructure capacity within the study area would be due to the generation of waste. Waste may be generated where materials on-site are not suitable for re-use and require management in accordance with the waste hierarchy[325]. Waste generated will likely include soils, aggregates, asphalt and concrete with smaller quantities of metals, wood and vegetation. In addition, small quantities of municipal waste and septic tank waste may also be generated by the workforce.

12.8.4 Minimal impact is envisaged during the operational stage of the Scheme due to limited material asset use (mostly associated with planned/unplanned maintenance) and waste generation. Most of the wastes would likely be non-hazardous municipal type wastes (e.g. litter) and non-hazardous/inert and hazardous wastes from planned/unplanned maintenance (concrete, bituminous materials, waste electrical and electronic equipment (WEEE), oils, etc.).

12.8.5 Due to the minimal impact anticipated, material asset use and waste generation during operation has been scoped out of the assessment.

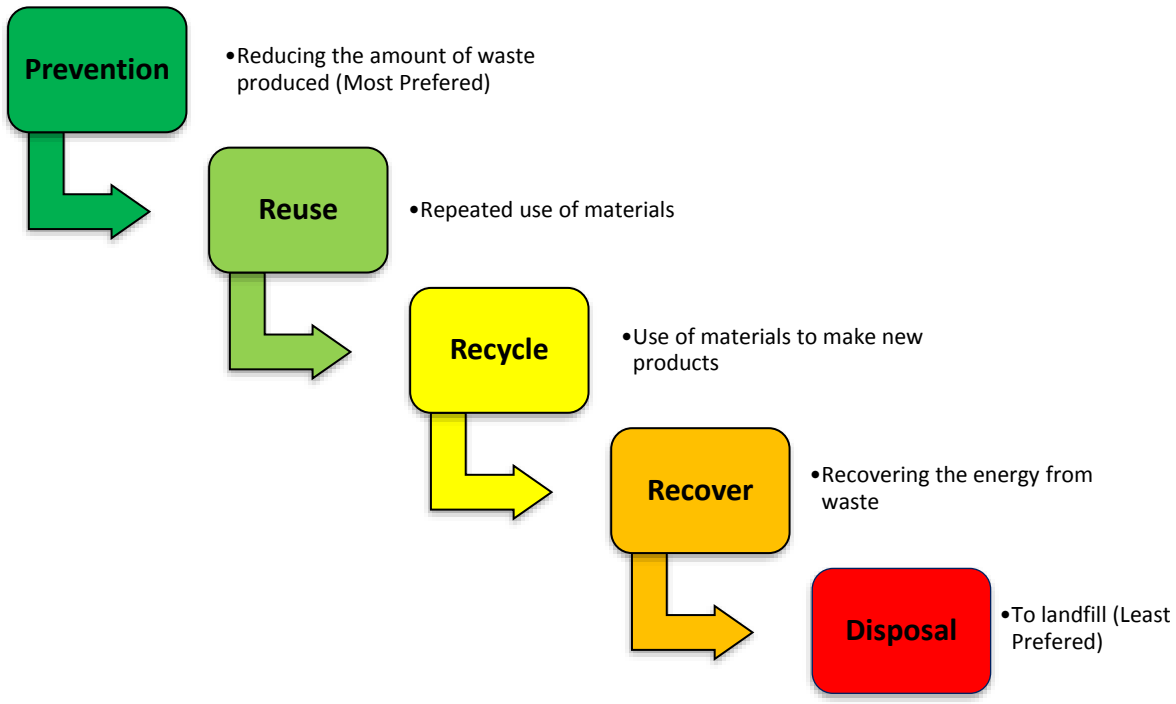
12.9 Design, mitigation and enhancement measures

12.9.1 Throughout the design process and following the assessment of significance, mitigation measures associated with material use and waste generation will be identified.

12.9.2 Although every effort will be made (through the design process) to maximise resource efficiency, it is inevitable that waste will be generated during each construction phase of the Scheme. This will have an impact on the regional waste infrastructure and regional waste arisings. The Scheme should prioritise waste prevention, followed by preparing for re-use, recycling and recovery and lastly disposal to landfill as per the internationally recognised waste hierarchy, shown below in Figure 12.1.

[325] Directive 2008/98/EC on waste (Waste Framework Directive) - http://ec.europa.eu/environment/waste/framework/

Figure 12.1: Waste hierarchy



12.9.3 Mitigation measures are necessary to reduce the environmental effects of both the CD&E and operational phases of the Scheme. The following sections detail the mitigation measures that should be implemented. Where applicable, design and enhancement measures have also been included. Many of the measures outlined in both the CD&E and operational sections are also mitigation measures for material assets.

Construction phase

12.9.4 There are several different design, mitigation and enhancement measures that can be utilised throughout the construction phase of the Scheme which will reduce the impact of material assets used and waste generated. These are detailed in the sections below.

Designing out waste

12.9.5 It is standard practice within the design process of the Scheme for material asset use and waste generation to be minimised as early as is practicable. As part of this Scheme, the following headline design decisions have been made to minimise material and waste impacts (these adjustments are included within the assessment):

- Realignment of the highway passing under Stockbury viaduct resulting in a reduction in the cutting and fill material that would have been required under the pier foundations; and
- Reduction in the cutting along the M2 westbound on-/off-slip road embankments, thus reducing the quantity of waste requiring disposal.

12.9.6 In addition, inherently as part of the Scheme design, the materials used:

- Are to industry standard specifications to fit the required design with minimal wastage where practicable;
- Are re-used/reclaimed (potentially from excavation and/or demolition), where practicable; and/or
- Are recycled or reclaimed, where practicable.

12.9.7 The UK's Waste Resources Action Programme (WRAP) has produced guidelines for design teams under the following headings:

- Re-use and recovery;
- Off-site construction;
- Materials optimisation;
- Waste efficient procurement; and
- Deconstruction and flexibility.

12.9.8 Further design improvements in terms of material use and waste generation will be explored after the ground investigation at the detailed design stage. The ground investigation will inform the design team if it is possible to treat and re-use site won material.

12.9.9 Should site won material not be suitable for re-use, the potential for recycled aggregate to be used within the Scheme will be considered prior to the use of virgin aggregate.

12.9.10 In addition, efforts should be made both by the designer and the contractor(s) to reduce the wastage rates of the construction waste streams which arise in the greatest quantities (e.g. inert materials and concrete).

12.9.11 The designer and/or contractor should explore opportunities for surplus excavated materials generated by the Scheme to be used as a material in another development(s) in Kent or beyond by use of the CL:AIRE Definition of Waste: Code of Practice or alternative method.

12.9.12 These factors will be considered and implemented during detailed design to improve the sustainability of the Scheme, including minimising waste to landfill.

<u>On-site management</u>

12.9.13 Best practice waste management, which will be considered include:

- Setting targets for waste recovery and recycling and communicating these to those working on the Scheme with a clear understanding of what is expected;
- Preparation and maintenance of an OEMP and a SWMP so that waste generation and management can be logged and audited;
- Using precast concrete and other materials that can be prepared off-site to minimise waste generation on-site;
- Using recycled materials wherever practicable, in particular, recycled aggregates to meet the South East England regional target set by the national and regional guidelines for aggregates provision in England;

- Not over ordering materials and using materials brought to site as efficiently as possible;
- Organising deliveries so materials arrive on-site as they are needed to reduce the possibility of damage and wastage occurring;
- Having clearly defined and separated skips on-site and a clearly demarked waste area(s);
- Training staff to understand how they should sort any waste material and providing regular reminders and updates; and
- Locally source materials, where practicable.

12.9.14 Best practice waste management not only reduces the environmental effects of a Scheme through reducing waste to landfill or incineration, but also offers cost benefits, as the cost of disposal to landfill or incineration is not needed.

Treatment and disposal

12.9.15 The contractor will aim to achieve at least a 70% recycling/recovery rate for all CD&E waste generated on-site as per the Waste Framework Directive target. This can be achieved by arranging for the source segregation of recyclable materials and the provision of appropriate recycling facilities. Achieving a high recycling rate will minimise the environmental burden in terms of pollution, energy consumption and emissions of CO_2 equivalent associated with the production of products from virgin material.

12.9.16 Across the country there are many waste collection and disposal companies. The principal contractor will select waste contractor(s) who are registered with the Environment Agency as a waste carrier for all CD&E waste to be transported, including hazardous waste. Completed waste transfer notes and/or hazardous waste consignment notes must be provided by the contractor. These should be kept for a minimum of two and three years respectively. Any site that waste is transferred to must also have either a permit or exemption that allows it to receive and manage the waste being transferred.

Operational phase

12.9.17 Although the operational phase is not being assessed, there is still an opportunity for mitigation measures to be considered where practicable:

- Any materials required for planned/unplanned maintenance should be managed in accordance with the best practice procedures outlined in the above sections;
- Recyclable waste should be source segregated. This can be achieved through the provision of clearly marked and/or colour-coded bins to enable easy identification of where waste should be placed during planned/unplanned maintenance;
- Hazardous waste should also be source segregated. Hazardous waste such as WEEE may arise during planned/unplanned maintenance and should be stored and collected separately. This is due to these wastes not being suitable for storage in standard waste receptacles due to human and environmental hazards and risks. Therefore, an area should be set aside, at

maintenance depots, for hazardous waste storage which should include appropriate containers, for example WEEE cages; and

- Regular training should be provided for staff and/or sub-contractors. The training should focus on the practices necessary to minimise waste and to facilitate good practice whilst undertaking litter picking and planned/unplanned maintenance.

12.10 Assessment of effects

Significant effects

Construction phase

Material assets

12.10.1 The material assets assessment of the Scheme is shown in Table 12.6 below. Quantities of material assets to be used have been sourced from the emerging design detail.

Table 12.6: Material assets assessment

Construction material	Material asset baseline (tonnes per annum)	Estimated material asset use (tonnes)	Percentage impact	Applicable threshold	Effect category
Aggregate	13,000,000	345,708	1.3%	≤50%	Slight
Concrete	6,025,000	84,146	0.7%	≤50%	Slight
Asphalt	1,600,000	60,000	1.9%	≤50%	Slight

Recycled aggregate assessment

12.10.2 This section assesses the quantity of recycled aggregate to be used on the Scheme against the 'National and regional guidelines for aggregates provision in England' recycled content target.

12.10.3 The quantity of total recycled aggregate to be used has been sourced from the emerging design detail.

12.10.4 Table 12.7 below presents the assessment.

Table 12.7: Recycled aggregate assessment

Total virgin aggregate to be used (tonnes)	Total recycled aggregate to be used (tonnes)	Percentage	South East recycled aggregate target	England's recycled aggregate target	Effect category
345,708	151	0.04%	26%	25%	Moderate

Waste infrastructure capacity assessment

12.10.5 Table 12.8 below presents the estimated quantities of waste to be generated by the Scheme. This information has been sourced from the emerging design detail

and includes cut/excavation waste, wastage from construction/material use and waste produced by the site compound and gatehouse demolition.

Table 12.8: Waste infrastructure capacity assessment

Waste stream	Waste infrastructure capacity (tonnes)	Waste generation (tonnes)	Percentage impact	Applicable threshold	Effect category
CD&E	11,966,494	423,926	3.5%	>1%	Moderate

Operational phase

12.10.6 The operational phase of the Scheme has not been assessed as outlined in Section 12.8.

Summary of CD&E significant effects

12.10.7 Table 12.9 applies the significance criteria from the guidance shown in Table 12.2 to the level of significance shown in Table 12.3, to identify whether the Scheme will have a significant impact on materials assets and waste.

12.10.8 As shown in Table 12.9, there will be no significant effects on material assets, however, waste infrastructure will be significantly affected by the Scheme.

Table 12.9: Summary of CD&E phase significant effects

Material assets effect category	Material assets significant / not significant	Waste infrastructure effect category	Waste infrastructure significant / not significant	Overall significance
Moderate	Not Significant	Moderate	Significant	**Significant**

Residual effects

12.10.9 The use of material assets and the generation of waste is an inevitable consequence of all forms of development and as such, there will be unavoidable impacts. The impact level can be reduced with mitigation measures during the detailed design and CD&E phases as outlined in Section 12.9.

12.10.10 However, prior to the detailed design stage, it is not possible to quantify the amount of material suitable for re-use on-site. A worst-case approach has therefore been taken and it has been assumed that none of the material will be suitable for re-use on-site. The level of residual effects and the significant effects consequently remain, as outlined above.

12.11 Cumulative effects

12.11.1 Twenty seven planning applications from Maidstone and Swale Borough Councils were reviewed for this task. The applications were provided by the Planning Team. Only three of the 27 applications had sufficient information relating to waste management (none had relevant information for material assets use).

12.11.2 Where the quantity of waste was provided in cubic metres, the WRAP 1.24 tonne per cubic metre conversion was used to calculate the estimated quantity of waste in tonnes, as shown below in Table 12.10.

Table 12.10: Summary of waste cumulative effects

Site name	Application reference	Estimated CD&E waste produced (tonnes)
Land at Woodgate Lane	15/507804/FULL	429
Land at Wises Lane	17/505711/HYBRID	6656
South of Sutton Road, Langley	15/509015/OUT	19555

12.11.3 The total amount of construction phase CD&E waste produced by these developments is estimated to be 26,640 tonnes. This will increase the impact on the waste infrastructure baseline by 0.2%. Therefore, the impact on waste infrastructure will remain significant.

12.11.4 It should be noted that of the planning applications reviewed, a number refer to proposed housing developments ranging between 200-800 homes. There may be significant quantities of waste produced by these developments which will produce a cumulative impact, which cannot be qualified without the relevant waste figures.

12.11.5 As previously mentioned, no material assets data was available from any of the developments reviewed. There will be various quantities of construction materials across the developments which will have a cumulative effect on material asset use.

12.12 Monitoring

12.12.1 Monitoring of waste generation during the construction, demolition and excavation phase will be carried out by the contractor via the SWMP and/or OEMP.

12.12.2 The focus of the SWMP will be monitoring the quantities and types of waste generated as well as the duty of care information for the contractors transferring the waste and the sites the waste is taken to for management.

12.12.3 The OEMP will provide more detailed information on the duty of care documents that will be needed such as the waste transfer notes and consignment notes.

12.13 Summary

12.13.1 A detailed material assets and waste assessment has been undertaken for the Scheme in accordance with IAN 153/11 (2011) and Highways England guidance.

12.13.2 The assessment has been undertaken prior to a detailed ground investigation. It has therefore not been possible to include quantities of material re-use on-site. The assessment therefore includes a precautionary approach and assumes that all material excavated during construction is not suitable for re-use on the site.

12.13.3 A review of baseline conditions of material assets shows the South East region's sales of aggregate (the main material asset to be used on the Scheme) to be 13,000,000 tonnes during the Scheme's construction phase. For waste, Kent has

the capacity to manage 5,983,247 tonnes per annum of CD&E wastes during the Schemes CD&E phase.

12.13.4 During construction, the use of material assets is predicted to have a moderate effect due to the minimal quantities of recycled aggregates to be used, this equates to a non-significant effect. For waste infrastructure capacity, the effect is estimated to be significant. Therefore, the overall effect of the Scheme is significant.

13. Population and Human Health

13.1 Introduction

13.1.1 The population and human health assessment will ascertain the likely potential positive and negative effects of the construction and operation of the Scheme, and opportunities for improving health and reducing inequalities.

13.1.2 The scope of the assessment has been revised and updated from that outlined in the Environmental Scoping Report (Atkins, October 2018) to reflect recent guidance and the approach to population and human health assessment agreed with Highways England.

13.2 Competent expert evidence

13.2.1 This population and human health assessment has been undertaken by Stuart Hardy who is a qualified Town Planner, BA (hons) MTCP, and member of the Royal Town Planning Institute. He has over 5 years town planning experience, including over 2 years of knowledge and experience in environmental assessment of people and communities and population and human health assessment, and has used his knowledge and professional judgement to undertake this assessment.

13.2.2 This population and human health assessment has been reviewed by Sarah Wallis who is a chartered Town Planner, MATP, BSc (hons) and holds full professional membership with the Royal Town Planning Institute (RTPI).

13.2.3 The population and human health chapter assessment has also been reviewed by Cristina West who is a chartered Environmental Scientist and holds full professional membership with the Chartered Institute of Water and Environmental Management (CIWEM).

13.3 Legislative and policy framework

13.3.1 Legislation, national and local planning policy have been used to inform the population and human health baseline, providing direction on relevant issues such as population, health, transport, land use and development. Key legislation and policy relevant to the Scheme is included in Table 13.1.

Table 13.1: Legislation, regulatory and policy framework for population and human health

Scale	Legislation/ regulation	Summary of requirements
National	National Networks National Policy Statement (December 2014)	The Government's vision and strategic objectives for the national networks include improving overall quality of life, journey quality, reliability and safety and linking up communities. Junction improvement is cited as a measure which will be used to enhance the existing national road network towards this vision (Paragraph 2.23). The NN NPS establishes the expectation that delivery of new schemes will improve quality of life and avoid and mitigate environmental and social impacts in line with the principles set out in the NPPF and the Government's planning guidance (Paragraph 3.3). Schemes will also be expected to improve accessibility and inclusivity and reduce community severance, to contribute to a network that provides a range of opportunities and choices for people to connect with jobs, services and friends and family (Paragraph 3.19). Although it does not provide specific guidance for people and communities impacts, the NN NPS outlines the approach to land use which is of relevance to this assessment. Applicants should identify existing and proposed land uses, including best and most versatile agricultural land, near the Scheme and the likely effects on these (Paragraphs 5.165 and 5.168). It is acknowledged in the NN NPS that new or enhanced national networks infrastructure can have direct (paragraph 4.79) and indirect (paragraph 4.80) impacts on health, wellbeing and the quality of life of the population. It further states that (paragraph 4.81) where a proposed project has likely significant environmental impacts that would have an effect on human beings, any environmental statement should identify and set out the assessment of any likely significant adverse health impacts. And that the applicant should identify measures to avoid, reduce or compensate for adverse health impacts as appropriate (paragraph 4.82).
	Revised National Planning Policy Framework (NPPF) 2019	The National Planning Policy Framework (NPPF) provides the policy framework for plan-making and decision taking on a national basis. The following list contains the key policies with key extracts from relevant objectives from those policies, from the NPPF: Policy 2: Achieving sustainable development: • Paragraph 7 – Sustainable development; • Paragraph 10 – Presumption in favour of sustainable development; and • Paragraph 11 – Application of the presumption in favour of sustainable development. Policy 6: Building a strong, competitive economy: • Paragraph 80 – Supporting businesses and economic growth; • Paragraph 81 – Enabling economic growth; and • Paragraph 82 – Specific locational requirements for businesses. Policy 8: Promoting healthy communities: • Paragraph 91 – Planning policies and decisions should aim to achieve healthy, inclusive and safe places;

Scale	Legislation/ regulation	Summary of requirements
		• Paragraph 97- Existing open space, sports and recreational buildings and land, including playing fields, should be replaced and enhanced unless a justification can be made that the facility is surplus to requirements or the development is for alternative provision which will provide greater benefits; and • Paragraph 98 – Public rights of way and access should be protected and enhanced. Policy 9: Promoting sustainable transport: • Paragraph 102 – Opportunities to promote walking, cycling and public transport, and to utilise changing transport technology should be taken; • Paragraph 104 – Supports the creation of sustainable development patterns; • Paragraph 108 – Promotes sustainable transport and road safety; • Paragraph 109 – Development should only be prevented or refused on highways grounds if there would be an unacceptable impact on highway safety, or the residual cumulative impacts on the road network would be severe; and • Paragraph 110 – Providing safe and secure access for all. Policy 12: Achieving well designed places: • Paragraph 127 – Sets out design standards, including that developments should be visually attractive as a result of appropriate and effective landscaping. • Paragraph 128 – Places emphasis on early and ongoing engagement. • Paragraph 130 – Design quality should not be diminished between approval and implementation. Policy 14: Meeting the challenge of climate change, flooding and coastal change: • Paragraph 148 – The Planning system should support the transition to a low carbon future in a changing climate. Policy 15: Conserving and enhancing the natural environment: • Paragraph 170 – Contributing to and enhancing the natural environment. • Paragraph 178 – A site should be suitable for the proposed use, taking account of ground conditions, land stability and any contamination. • Paragraph 180 – New development should be appropriate to its location, and adverse impacts to surrounding uses, including impacts to human health, should be mitigated. • Paragraph 181 – Air quality should be actively sustained and enhanced. • Paragraph 182 – Existing businesses and facilities should not have unreasonable restrictions placed upon them by new development.
	Planning Practice Guidance (PPG) 2014	The Air Quality chapter seeks to manage and improve air quality. The Guidance sets out that consideration of the acceptability of a development proposal should include new sources of air pollution, and the exposure of neighbouring uses

Scale	Legislation/ regulation	Summary of requirements
		and biodiversity to existing sources of air pollution (Paragraph - 005, Reference ID - 32-005-20140306, Revision Date – 6th March 2014). Under the Health and Wellbeing section, it is stipulated that 'local planning authorities should ensure that health and wellbeing are considered in planning decision making' (Paragraph – 001, Reference ID - 53-001-20140306, Revision Date – 6th March 2014). The Natural Environment section includes the stipulation that development should achieve net gains for nature, in line with the NPPF.
	Countryside and Rights of Way Act 2000	The Countryside and Rights of Way Act 2000 (CRoW) regulates all Public Rights of Way (PRoW) and ensures access to them. It requires local highway authorities to publish a Rights of Way Improvement Plan (RoWIP), which should be reviewed every 10 years. The Act also obliges the highway authority to recognise the needs of the mobility impaired when undertaking improvements.
	Road Investment Strategy (RIS) and Strategic Business Plan 2015	The RIS aims to improve connectivity, safety, air quality and road user satisfaction, boost the economy whilst reducing noise and negative environmental impacts all of which will have an impact on local communities and people.
Local	Bearing Fruits 2031, Swale Borough Council, July 2017.	• Policy ST 1: Delivering sustainable development in Swale; • Policy CP 2: Promoting sustainable transport; • Policy CP4: Requiring good design; • Policy CP 5: Health and wellbeing; • Policy CP 6: Community facilities and services to meet local needs; • Policy DM 6: Managing transport demand and impact; • Policy DM 14: General development criteria; and • Policy DM31: Agricultural Land seeks, wherever feasible, to protect agricultural land and BMV land in particular. The strategy emphasises the need to relieve problems of congestion and safety at Junction 5 of the M2 and A249 these issues are also addressed by the national roads programme. Junctions on the A249 corridor also need upgrading to support further long-term growth.
	Swale Local Transport Strategy Draft 2014-2013	The transportation strategy for Swale is a comprehensive document identifying transport issues and potential solutions within the Borough. A key transport issue identified is the congestion at M2 Junction 5; this congestion acts as a barrier to further development in Swale.
	Maidstone Borough Local Plan, Maidstone Borough Council, adopted October 2017.	• Policy SP 2 identifies key highway and infrastructure requirements including improvements to the M20 junction 5 roundabout. • Policy DM1: Principles of good design; • Policy SP22: Retention of employment sites; and • Policy SP23: Sustainable transport.

Scale	Legislation/ regulation	Summary of requirements
		In 8.10, under Development Management Policies in the Countryside protection the need to protect BMV land, wherever feasible, is recognised.
	Medway Council Local Plan 2003	The local plan identifies the need for traffic management including improving the road network's capacity using measures such as one-way systems and linking traffic lights along a stretch of road. Medway Council is currently working on a new Local Plan, which will replace the 2003 Plan. This is likely to be issued in 2019.
	Medway Council Strategic Plan 2004	The plan identifies a core objective to reduce traffic congestion within urban areas and improving public transport systems.
	Medway Council Plan 2016/17-2020/21 2017/18 Update	The Council's business plan sets out how the Council will provide the best possible services for its residents. The plan identifies the need to tackle congestion hotspots.
	Swale 'Looking Ahead' (April 2018)	Swale Borough Council has published the consultation and engagement document 'Looking Ahead' (April 2018) to shape and scope the content of the next Local Plan.
Other	Other Strategic Policies	The following strategic policies are also material considerations relating to this chapter: • The Kent Local Transport Plan 4: Delivering Growth without Gridlock 2016-2031; • Swale Transportation Strategy Draft 2014-2031; • Maidstone Integrated Transport Strategy 2011-2031; and • Medway Local Transport Plan 2011-2026.

Table Source: Various

Health policy and strategic framework

13.3.2 The human health baseline has been established through analysis of the local and sub-regional public health data and a review of legislation, sub-regional and local health studies and strategies, which include:

- Fair Society, Healthy Lives (the Marmot Review) 2010;
- Health and Social Care Act 2012;
- Public Services (Social Value) Act 2012;
- [Public Health England] Strategic plan for the next four years: Better outcomes by 2020;
- Kent Joint Strategic Needs Assessment (JSNA);
- Kent Joint Health and Wellbeing Strategy – Outcomes for Kent 2014-2017;
- Kent and Medway integrated care pioneer assembly Five Year Forward View (October 2014);

- Kent Health Inequalities Action Plan – Mind the Gap 'Building bridges to better health for all'; and
- Kent Local Transformation Plan for Children, Young People and Young Adults' Emotional Wellbeing and Mental Health (October 2017).

13.4 Study area

13.4.1 The effects for population and human health will be assessed within the following study areas:

- A core study area (1) consisting of a 500 m buffer from the Scheme boundary, to initially scope likely receptors and impacts of the Scheme. By using professional judgement and knowledge of the Scheme, this study area is considered likely to capture the key sensitive receptors and relevant impacts/effects resulting from the Scheme;
- A core study area (2) used to define the characteristics and sensitivity of communities near the Scheme based on the likely effects on physical, mental and social wellbeing. This study area is defined using the 'best-fit' of Lower Layer Super Output Areas (LSOAs) that cover the extent of the Scheme. LSOAs are a geographic hierarchy designed to improve the reporting of small area statistics in England and Wales. The selected LSOAs are listed below and mapped in Figure 13.1:
  - Maidstone 011D (within the North Downs ward);
  - Swale 008A (within the Hartlip, Newington and Upchurch ward);
  - Swale 008B (within the Hartlip, Newington and Upchurch ward);
  - Swale 009A (within the Borden ward); and
  - Swale 013C (within the West Downs ward).

Figure 13.1: Core study area displayed as highlighted LSOAs

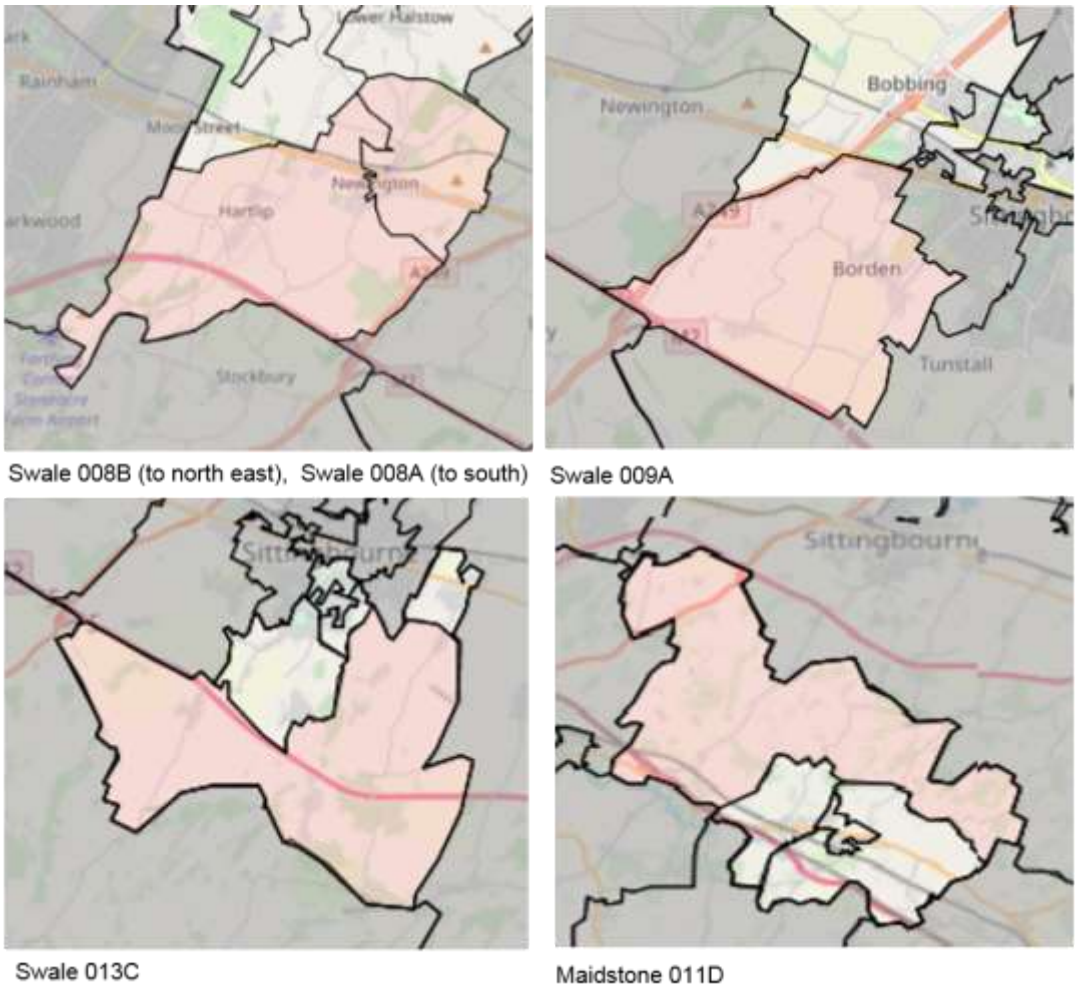


Figure Source: ONS Census 2011

- As effects are derived from changes in wider health determinants largely selected from the other technical assessments undertaken as part of the Environmental Statement (e.g. Air Quality (Chapter 5), Noise and Vibration (Chapter 6), Road Drainage and the Water Environment (Chapter 8)), the core study areas will also include that used for each determinant. In addition, this chapter also takes into account the assessments undertaken in the Equality Impact Screening and Assessment for the Scheme[326].

Chapter 5: Air Quality:

- Construction – within 200 m of the construction site, to assess the potential effects of construction dust during the construction phase; receptors identified within 200 m of the affected road networks (ARN), to assess the potential effects of construction traffic;
- Operation – within 200 m of the Scheme extent and the following affected roads: M2, A2 and A249;

[326] M2 Junction 5 Equality Impact Screening and Assessment, February 2019.

Chapter 6: Noise and Vibration:

- Construction – 300 m from the anticipated boundary of the physical works associated with the Scheme;
- Operation – 600 m from the carriageway edge of any proposed new routes, existing routes to be bypassed or improved, or any other affected routes within 1 km of the Scheme;

Chapter 8: Road Drainage and the Water Environment:

- Construction and operation – features of the water environment within 1 km of the Scheme;

Chapter 9: Landscape and Visual:

- Construction and operation – 2 km wide radius around the Scheme, covering the area that the Scheme may influence significantly;

Chapter 10: Geology and Soils:

- Construction and operation – the Scheme boundary and an area extending 500 m from the boundary; and

Equality Impact Screening and Assessment:

- Construction and operation – 1 km core scheme assessment area.

- A wider study area used to define the characteristics and sensitivity of communities and the context in which NHS organisations and the local economy operates. This includes the NHS England and Clinical Commissioning Group (CCG) areas; local authority districts of Swale and Maidstone within which the Scheme itself is located; the other notable local authority districts in the wider area (e.g. Medway, and Tonbridge and Malling); and the county and regional areas of Kent and the South East, which includes Port traffic.

13.4.2 The above-mentioned core and wider study areas have been defined based on the extent and characteristics of the Scheme and the location, characteristics and sensitivity of communities and associated facilities/amenities.

13.4.3 By using DMRB guidance and professional judgement, industry best practice and knowledge of the Scheme, it is considered that these study areas will capture all (or most) relevant population and human health impacts and effects, including those on physical, mental and social wellbeing, resulting from the Scheme.

13.5 Assessment methodology

13.5.1 This ES has required a review of the conclusions of the Environmental Scoping Report (Atkins, October 2018) and an update of the baseline data where relevant. Where there are no consolidated significance criteria for assessments of some receptors, bespoke assessment methodologies have been used in line with relevant methodology from DMRB guidance and professional judgement.

13.5.2 The assessment methodology is based on guidance provided by Highways England, including DMRB Volume 11, which requires a consideration of health

effects as well as socio-economic effects. The following DMRB guidance has been adopted:

- Population (physical assets and amenity and access):
  - Equestrians, Cyclists and Community Effects: DMRB Volume 11 Section 3 Part 8; and
  - Land Use: DMRB Volume 11 Section 3 Part 6 (excluding Agricultural land use).
- Human health:
  - Air Quality: HA 207/07, IAN 185/15, IAN 175/13, IAN 174/13, IAN 170/12;
  - Noise and Vibration: HD213/11, IAN 185/15;
  - Road Drainage and the Water Environment: HD 45/09;
  - Equestrians, Cyclists and Community Effects: DMRB Volume 11 Section 3 Part 8; and
  - Vehicle Travellers: DMRB Volume 11 Section 3 Part 9.

Information used in the assessment

13.5.3 The following supplementary information has been obtained from local, sub-regional and national public health data, health strategies and joint strategic needs data, and ONS NOMIS 2018 census data to inform the assessment:

- Population – qualitative information on access to and loss of open space/ green space or recreational facilities
- Human health – the public health profile at best fit of Lower Layer Super Output Areas (LSOAs) of the Scheme area with reference to communities with the following features:
  - Communities with increased susceptibility (potential issue) to health issues (i.e. % population under 16 and % over 65) compared to national average data;
  - Communities with increased vulnerability (pre-existing issue) to health issues (i.e. 'Emergency Hospital Admissions Chronic Obstructive Pulmonary Disease (COPD)' and 'Respiratory Disease as Cause of Death') compared to national average data; and
  - Communities with increased susceptibility to economic changes (i.e. % income deprivation and long-term unemployment) compared to national average data.

13.5.4 This chapter is divided into two main sections: population and human health, and further sub-divided as follows:

- Population (physical assets and amenity and access):
  - Private dwellings – land take and changes in access;
  - Community land and facilities – changes in access;
  - Rural enterprises;

  - Local businesses;
  - Development land; and
  - Non-motorised users (NMU) – pedestrians, cyclists and equestrians.
- Human health:
  - Air pollution;
  - Risk of injuries and death;
  - Soil and water pollution;
  - Access to housing, education, health care services and other social infrastructure;
  - Access to work and training;
  - Noise pollution and vibration; and
  - Vehicle travellers.

Informative note

13.5.5 The above assessment sub-topics have evolved since the production of the Environmental Scoping Report (Atkins, October 2018). To align with recent Highways England guidance, land effects associated with agricultural land use are now reported within the Geology and Soils chapter (Chapter 10). This was scoped out of the Population and Human Health chapter in October 2018. However, any impacts on farmers as business people through diversification into non-agricultural business activities are now considered within this chapter.

13.5.6 The human health sub-topics scoped in for assessment have been updated to more closely follow IEMA guidance on the UK public health profession's 'wider determinants of health' model.

13.5.7 The sub-topics that have been assessed are set out below, with cross-reference to the topics originally scoped in, in October 2018. Justification is given on how these sub-topics have been replaced or will be dealt with elsewhere within the assessment.

<u>Environmental Scoping Report (October 2018) – sub-topics scoped in for assessment:</u>

- Non-motorised users (covered in the population section of this chapter);
- Public health (now covered generally by all wider health determinants in the human health section of this chapter);
- Economic change (covered in 'local businesses' in the population section, and the 'access to work and training' wider health determinant in the human health section of this chapter).
- Air quality (now covered in the 'air pollution' wider health determinant in the human health section of this chapter);
- Noise and vibration (now covered in the 'noise pollution and vibration' wider health determinant in the human health section of this chapter);
- Road drainage and the water environment (now covered in the 'soil and

water pollution' wider health determinant in the human health section of this chapter);

- Community effects (now covered in 'community land and facilities' in the population section of this chapter); and
- Vehicle travellers (now covered in the human health section of this chapter).

Environmental Statement – sub-topics to be assessed:

- Air pollution;
- Risk of injuries and death;
- Soil and water pollution;
- Access to housing, education, health care services and other social infrastructure;
- Access to work and training;
- Noise pollution and vibration; and
- Vehicle travellers.

Sensitivity of receptors

13.5.8 The sensitivity of receptors is determined by their capacity to cope with change. For population and human health, the sensitivity of receptors in the study area is shown in Table 13.2.

Table 13.2: Sensitivity of receptors

Sensitivity	Criteria
Negligible	Receptor/resource is very low in importance and rarity.
Low	Receptor/resource has low vulnerability to change. Can easily absorb changes due to the following (or similar) reasons: • Resource is infrequently used; and • Reasonable alternative facilities, access routes or opportunities available.
Medium	Receptor has a limited ability to absorb change for the following (or similar) reasons: • Resource is semi-frequently used; and • Limited range of reasonable alternative facilities, access routes, or opportunities available.
High	Receptor is sensitive to change. Little ability to absorb change for the following (or similar) reasons: • Resource is frequently used; and • No reasonable alternative facilities, access routes or opportunities available.
Very High	Receptor/resource is very high in importance and rarity. Receptor is very sensitive to change. Very little ability to absorb change for the following (or similar) reasons: • Resource is very frequently used; and • Very limited potential for reasonable alternative facilities, access routes, or opportunities available.

Table source: Based on DMRB HA 205/08 Table 2.1

13.5.9 Based on the sensitivity criteria set out above, Table 13.3 sets out the indicative sensitivity of receptors that will be considered within this assessment.

Table 13.3: Sensitivity of assessment receptors

Topic	Receptor	Indicative sensitivity
Private dwellings	Residential property.	High
Community land and facilities	Designated local green space / valued community facility.	High
	Undesignated local green space / non-essential community facility.	Low
Community severance	Essential services/facilities for local community (required).	High
	Non-essential services/ facilities for local community (desirable).	Low
Local businesses	Businesses where viability is very likely to be permanently jeopardised by a short disruption to access or worsening of trading conditions.	Very High
	Businesses where viability is likely to be permanently jeopardised by a short disruption to access or worsening of trading conditions.	High
	Businesses where profitability may be harmed by a short or medium-term disruption to access or worsening of trading conditions.	Medium
	Businesses that could continue to operate without substantial harm if affected by a disruption to access or worsening of trading conditions.	Low
	Businesses that could continue to operate relatively unharmed if affected by a disruption to access or worsening of trading conditions.	Negligible
Rural enterprises	Farm types or land-based enterprises in which the operation is dependent on the spatial relationship of land to key infrastructure, and where there is a requirement for frequent and regular access between the two, or dependent on the existence on the infrastructure itself, e.g. dairying; irrigated arable cropping and field scale horticulture; intensive livestock or horticultural production; equestrian centres.	High
	Farm types or land-based enterprises in which there is a degree of flexibility in the normal course of operations, e.g. combinable arable crops; grazing livestock farms (other than dairying).	Medium
	Farm types and land uses undertaken on a semi-commercial or non-commercial basis such as occasional grazing by horses.	Low
	Agricultural land in a long-term state of disuse and reverting to scrub.	Negligible
Non-motorised users	All NMUs, key sensitive groups including families with children and adolescents, people who are physically or mentally disadvantaged, people of certain ethnicity and/or gender and people who are materially disadvantaged (these	High

Topic	Receptor	Indicative sensitivity
	are often overlapping groups and individuals and groups may be part of more than one of these categories).	
Human health	Health receptor that would be expected to be directly affected. Receptor is very well placed to take advantage of beneficial impacts, and/or is very poorly placed to deal with any adverse impacts.	Very High
	Health receptor that would be likely to be directly affected. Receptor is well placed to take advantage of beneficial impacts, and/or is not well placed to deal with any adverse impacts.	High
	Health receptor that would be likely to be indirectly affected. Average ability to maximise beneficial impacts or cope with adverse impacts.	Medium
	Health receptor that would be unlikely to be affected. Receptor is not well placed to take advantage of beneficial impacts, and/or is well placed to deal with any adverse impacts.	Low
	Health receptor that would be unlikely to be affected or effects would be temporary in nature, or which would be anticipated to have a slight or no effect on human health.	Negligible
Vehicle travellers	Public transport, motor vehicles.	Low

Table source: Atkins own methodology 2018

Magnitude of impact

13.5.10 To determine the significance of potential effects, the magnitude of impact is taken into consideration using professional judgement. The criteria used to determine the magnitude of any change in baseline conditions are presented in Table 13.4 to Table 13.8 in the population sub-section below and Table 13.14 in the human health sub-section. The magnitude of impact is primarily derived from the following impact parameters:

- Geographical scale of impact;
- Duration of impact (temporary, short-term, permanent, long-term);
- Frequency of impact (continuous, intermittent, changeable or constant); and
- Whether the impact is reversible or irreversible.

13.5.11 The magnitude of impact has been assessed against the sensitivity of receptors to determine the significance of potential effects. Significant effects are explained in paragraph 13.5.44.

Population

Private dwellings: land take and changes in access

13.5.12 Land take has been assessed in accordance with DMRB Volume 11, Section 3, Part 6. The assessment confirms the amount of land potentially affected by

demolition and/or land take and categorises the impacts on affected land accordingly.

13.5.13 Demolition, loss of land, and alterations to access have been considered as land take effects. Land take effects may either result in temporary impacts during construction, or permanent impacts occurring during construction, which will continue to be observed during the operational phase. No land take impact would occur during operation. Using professional judgement, impact has been assessed according to the criteria set out in Table 13.4, which has been adapted from Table 2.2 in HA 205/08.

Table 13.4: Assessment criteria for magnitude of impacts from land take to private dwellings

Magnitude	Criteria (all high sensitivity receptors)
Major (adverse)	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements.
Moderate (adverse)	Loss of resource, but not adversely affecting the integrity; partial loss of/ damage to key characteristics, features or elements.
Minor (adverse)	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to one (maybe more) key characteristics, features or elements.
Negligible	No loss or detrimental alteration to one or more characteristics, features or elements.

Table Source: adapted from Table 2.2 in HA205/08

13.5.14 Significance is the product of the sensitivity of receptors and magnitude of impact. The significance of effects within this assessment has been measured according to the significance of effect matrix, Table 13.14 below.

Community land and facilities: changes in access

13.5.15 Changes in access for community land and facilities is concerned with the role of roads as a barrier between different parts of the community resulting in changes to journey patterns and the impact of the Scheme on accessibility to and from communities and their facilities.

13.5.16 In accordance with DMRB Volume 11, Section 3, Part 8, the magnitude of impact for assessing changes in access has been described using a four-point scale: Major, Moderate, Minor, and Negligible, according to the criteria set out in Table 13.5.

Table 13.5: Assessment criteria for magnitude of changes in access to community land and facilities

Magnitude	Criteria
Major	In cases of severe changes in access, people are likely to be deterred from making trips to an extent sufficient to induce a re-organisation of their habits. This would lead to a change in the location of centres of activity or in some cases to a permanent loss of a particular community. Alternatively, considerable hindrance will be caused to people trying to make their existing journeys. For example, a change in journey length of more than 500 m.

Magnitude	Criteria
Moderate	In cases of moderate changes in access, some residents, particularly children and elderly people, are likely to be dissuaded from making trips. Other trips will be made longer or less attractive. For example, a change in journey length of between 250 m and 500 m.
Minor	Generally, in cases of slight changes in access current journey pattern is likely to be maintained, but there will probably be some hindrance to movement. For example, a change in journey length of less than 250 m.
Negligible	Little or no overall changes in access

Table Source: adapted from DMRB Volume 11, Section 3, Part 8, chapters 2 to 6

13.5.17 The significance of effects within this assessment has been measured according to the significance of effect matrix, Table 13.14.

13.5.18 Impact of severance on pedestrians, cyclists and equestrians is reported under the non-motorised users sub-heading.

Rural enterprises

13.5.19 The sensitivity criteria for rural enterprises is shown in Table 13.3.

13.5.20 In accordance with the latest Highways England guidance, the agricultural land effects associated with land take and severance are now dealt within the Geology and Soils chapter (Chapter 10) of the ES. Any impacts on farmers as residents or business people is assessed within population and human health. As there is no prescriptive DMRB guidance, a qualitative assessment of the potential impact of the Scheme on rural enterprises during construction and operation has been undertaken using professional judgement. The magnitude of impact has been assessed using the criteria in Table 13.6.

Table 13.6: **Assessment criteria for magnitude of impacts to rural enterprises**

Magnitude	Criteria
Major	The identified impacts are predicted to result in very large damage to a farm business or rural land-based enterprise and may compromise its viability.
Moderate	The identified impacts are predicted to result in moderate or large damage to a farm business or rural land-based enterprise, but with changes to management it should remain viable.
Minor	The identified impacts are predicted to result in slight or moderate damage to a farm business or rural land-based enterprise, but with minor changes to management it should continue as before.
Negligible	The identified impacts are predicted to result in little or no damage to a farm business or rural land-based enterprise.

Table Source: Adapted from DMRB Volume 11, Section 3, Part 6 Land Use

13.5.21 The significance of effects on rural enterprises has been measured according to the significance of effect matrix, Table 13.14.

Local businesses

13.5.22 A qualitative assessment of the potential impacts of the Scheme on local businesses has been undertaken, considering receptors in proximity and the likely socio-economic effects. In the absence of prescriptive DMRB methodology, the criteria used for the assessment of impact magnitude is based on a bespoke set of assessment criteria which has been developed using professional judgement and best practice, as set out in Table 13.7.

Table 13.7: Assessment criteria for magnitude of impacts to local businesses

Magnitude	Criteria
Major	An impact that is expected to have considerable adverse or beneficial socio-economic effects. Such impacts will typically affect large numbers of businesses, workers or residents.
Moderate	Moderate magnitude impacts will typically be long-term in nature, resulting in the permanent change of the study area's baseline socio-economic conditions.
Minor	An impact that is expected to have a minor socio-economic effect. Such impacts will typically have a noticeable effect on a limited number of businesses, workers or residents, and will lead to a permanent (but not drastic) change to the study area's baseline socio-economic conditions.
Negligible	An impact that is expected to affect a small number of businesses, workers or residents. Or an impact that may affect a larger number of receptors but without materially changing the study area's baseline socio-economic conditions. Such impacts are likely to be temporary in nature.

Table Source: Atkins own methodology 2018

13.5.23 The significance of effects has been measured according to the significance of effect matrix, Table 13.14.

Non-motorised users: journey length and local travel patterns

13.5.24 Using the methods set out in DMRB Volume 11, Section 3, Part 8, chapters 2 to 6, changes in journey lengths and patterns has been assessed using the criteria set out in Table 13.8.

Table 13.8: Assessment criteria for magnitude of impacts to non-motorised users

Magnitude	Criteria
Major Beneficial	Substantial improvement to NMU network through provision of new amenities for pedestrians and cyclists where there is no existing route. NMUs navigate route with a decrease in traffic flows of over 50% AADT. Decrease in journey length by over 500 m.
Moderate Beneficial	Improvement to existing NMU network through new amenities, where there are none or few existing amenities. NMUs navigate route with decrease in traffic flows of 30% - 50% AADT. Decrease in journey length by 250-500 m
Minor Beneficial	Improvement of existing NMU network through upgrading of existing amenities or provision of new amenities where some already exist. Decrease in journey length by up to 250 m.

Magnitude	Criteria
Negligible /No change	No change to traffic flows or NMU amenity. No provision of new amenities. No substantial change in journey length.
Minor Adverse	Existing facilities worsen. Increase in journey length by up to 250 m.
Moderate Adverse	Existing facilities worsen. NMUs navigate route with increase in traffic flows of 30% - 50% AADT. Increase in journey length by 250-500 m.
Major Adverse	Substantial harm to NMU route and degradation of amenities. Closure or removal of existing NMU routes. NMUs required to navigate route with an increase of traffic flows of over 50% AADT. Increase in journey length by over 500 m.

Table Source: adapted from DMRB Volume 11, Section 3, Part 8

Non-motorised users: changes in amenity

13.5.25 Amenity for non-motorised users is defined in DMRB Volume 11, Section 3, Part 8, sub-section 4 as “the relative pleasantness of a journey”. In assessing amenity for the routes used by pedestrians and others, a descriptive approach has been employed to give an indication of the change in amenity and the likely number of journeys affected, including reasoned judgement. Changes in amenity as a result of the Scheme have been assessed using the criteria set out in Table 13.8.

Non-motorised users: severance

13.5.26 Changes in journey times and amenity for pedestrians and others may be such that they affect, adversely or beneficially, the degree to which a locality is subject to community severance. Community severance includes the separation of residents from facilities and services they use within their community caused by new trunk roads or changes in traffic flows.

13.5.27 Severance has been described using a three-point scale: Slight, Moderate or Severe severance, in line with the guidance set out in DMRB Volume 11, Section 3, Part 8, sub-section 6.

Reporting of assessment of non-motorised users

13.5.28 The assessment of NMU in terms of changes in journey length, travel patterns, amenity and severance has been reported under a combined schedule, in the essence of proportionate and lean reporting.

Human health

Identifying the sensitive receptors

13.5.29 Despite the requirement to consider ‘population and human health’ amongst the other environmental topics for assessment, the May 2017 EIA Directive does not establish the way in which the topic is to be addressed and there is no prescribed EIA definition for ‘population and human health’. In the absence of DMRB consolidated methodology or practice for human health, the human health

part of this assessment is based upon Institute of Environmental Management and Assessment (IEMA) guidance contained in 'Health in Environmental Impact Assessment: A Primer for a Proportionate Approach' (IEMA 2017) and the World Health Organisation (WHO) definition of health used by the public health profession in the UK, health is defined as 'a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity.'[327]

13.5.30 The human health assessment considers the effects of the Scheme on both the health of the population likely to be affected by the Scheme overall and the distribution of those impacts within the affected population.

13.5.31 For the local population overall, the key challenges to physical health, mental and social wellbeing arise from inactivity and unhealthy lifestyle choices and the way they interact with roads, traffic and the local transport network. In this context residents of properties in the study area; residents using open space, greenspace and recreational facilities in the study area; residents travelling to/from, and using, local services in the study area; employees and customers at businesses in the study area; pedestrians and cyclists using recreation routes and the local footpath, cycleway and road network; visitors to tourist attractions in the study area; and public transport users in the study area, are likely to be exposed to health impacts arising from the Scheme.

13.5.32 It is well established in the UK and internationally that the factors that influence health and wellbeing within the affected population vary by age, gender, ethnicity, disability, income and social support. The most sensitive or vulnerable members in society often stand to lose the most from both the construction and operational stages of a project and this can lead to health inequality and health and social equity issues which must be addressed.

13.5.33 In this human health assessment, alongside considering the local population overall, consideration is also given to particular sensitive population sub-groups as changes to health determinants originating from a transport scheme (see Table 13.10 for further information) can have disproportionate effects on certain sensitive sub-groups. This can then be used to inform the iterative design process, with the aim of maximising the Scheme's positive health effects and minimising its negative health effects across all identified sensitive sub-groups.

13.5.34 The following sensitive population sub-groups have been identified for assessment: families with children and adolescents; people who are physically or mentally disadvantaged (e.g. elderly people, people with physical and/or disabilities, people with other health problems or impairments); people of certain ethnicity and/or gender; and people who are materially disadvantaged (e.g. people on low income, people with no car, unemployed people). These sensitive sub-groups include particular types of health receptors that are more likely to be susceptible to the Scheme's impacts due to various factors, as explained in Table 13.9 below.

[327] Pre-amble to the Constitution of the World Health Organisation (https://www.who.int/governance/eb/who_constitution_en.pdf)

Table 13.9: Sensitive sub-groups

Sensitive sub-group	Location	Justification
Families with children and adolescents (pregnant women, babies, children and adolescents)	Residential houses, open space, PRoWs and footpaths, community facilities	Children and adolescents constitute a sensitive population group due partly to their need to be able to move around freely to and from school and recreational activities, whilst they lack the experience and judgement displayed by adults when moving around in traffic and public spaces[328]. Hence, children and adolescents as pedestrians[329] and cyclists are at elevated risk from danger distributed by motorised transport. Furthermore, children are more sensitive than adults to air pollution[330], noise[331], odour[332] and other environmental factors and their bodies and minds are less able to deal with them. Particularly susceptible children are those from low-income[333] and/or black and minority ethnic (BME) backgrounds[334] and/or living in deprived areas. Pregnant women are more sensitive when travelling on public transport as they may feel nauseous whilst women and/or men with babies often carry additional child related equipment and require appropriate facilities to accommodate pushchairs for example[335]. This can deter them from travelling unless their specific needs are catered for.
People who are physically or mentally disadvantaged (elderly people, people with physical disabilities, people with other health problems or impairments)	Residential houses, open space, PRoWs and footpaths, bus stops, community facilities	Elderly people constitute a sensitive group as they are more sensitive than young and middle-aged adults. Generally, the older people are, the slower their movement and reactions and the poorer their hearing[336]. They can be more at risk from injury and may also fear falls, lack of safe crossing points and short crossing times at safe crossing points and other aspects of the built environment[337]. This can deter them from outdoor activity, especially walking, whereas walking is critical for muscle strength and reduces the risk of falls amongst other benefits. They find the neighbourhood setting particularly anxiety-provoking and worrying leading to withdrawal and isolation or an increase in accidents.

[328] World Health Organisation (2018, December) Adolescents: health risks and solutions (https://www.who.int/news-room/fact-sheets/detail/adolescents-health-risks-and-solutions)
[329] Child Accident Prevention Trust (2013) Child death from road traffic accidents (http://makingthelink.net/child-deaths-road-traffic-accidents)
[330] World Health Organisation (2018) Air pollution and child health: prescribing clean air (https://www.who.int/ceh/publications/air-pollution-child-health/en/)
[331] World Health Organisation Data and statistics (http://www.euro.who.int/en/health-topics/environment-and-health/noise/data-and-statistics)
[332] Agency for Toxic Substances and Disease Registry (2015, October) (https://www.atsdr.cdc.gov/odors/faqs.html)
[333] British Medical Journals, Wickham. S, Anwar. E, Barr.B, Law. C, Taylor-Robinson.D (2016, July) Poverty and child health in the UK: using evidence for action (https://adc.bmj.com/content/101/8/759)
[334] Parliamentary Office of Science and Technology (2007, January) (https://www.parliament.uk/documents/post/postpn276.pdf)
[335] Price, L., & Matthews, B. (2013). Travel time as quality time: Parental attitudes to long distance travel with young children. Journal of Transport Geography, 32, 49–55 (http://cel.webofknowledge.com/)
[336] Transport for London (2013, April) Older Pedestrians and Road Safety, Research Debrief (http://content.tfl.gov.uk/older-pedestrians-research-report.pdf)
[337] Asher. L, Aresu. M, Falaschetti. E, Minell. J (2012) Most older pedestrians are unable to cross the road in time: a cross-sectional study (http://ageing.oxfordjournals.org/content/41/5/690.full.pdf+html?sid=4b5142fa-92a1-4cd5-80b1-4eb35701432e)

Sensitive sub-group	Location	Justification
		Elderly people can also feel more sensitive using public transport[338][339]. They also often need to seek health services. Their continuing independence at home is often dependent on having available a range of transport mode and route options. People who are disabled and/or with physical and/or mental illnesses or impairments constitute a sensitive group as they may not be able to access many forms of transport or need special arrangements and/or support to access these[340]. They are more likely to find it difficult to walk or travel independently and can also be disadvantaged by the cost of transport. Chronically ill persons, for example, people with impaired lung function, can be more adversely affected by air pollution[341]. The same is true of hypersensitive individuals such as asthmatics[342]. Noise can cause hypertension and cardio-vascular problems[343]. Those who already have these conditions can be more troubled by noise than others. People with existing physical and mental illnesses, including sleep disturbance, anxiety and depression, are likely to be more sensitive to changes to their local environment.
People of certain ethnicity and/or gender	Residential houses, local businesses, farmsteads, bus stops, community facilities	Some people express concerns about using public transport and /or accessing local services and work places because of their gender or ethnicity or because they need to travel at certain times of the day or night[344]. These concerns include walking to, and waiting, at bus stops. In particular, women travellers may be more reliant and feel more sensitive using public transport, noting that women carry out a higher number of local bus stages per person per year (67 in England in 2016) than men (52 in England in 2016)[345]. Some women may also have more safety and security concerns when travelling alone or alone after dark[346].
People who are materially disadvantaged (low income,	Residential houses, local businesses, open space, PRoW and footpaths, bus	People on low incomes (living in deprived areas is a proxy measure for low income) and people without access to a car constitute a sensitive group as they are likely to walk further[347] because they cannot afford public transport or to

[338] Shrestha.B.P, Millonig.A, Hounsell.N.B, McDonald.M (2017) Review of Public Transport Needs of Older People in European Context (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5656732/)
[339] https://www.ageuk.org.uk/globalassets/age-uk/documents/reports-and-publications/reports-and-briefings/active-communities/rb_june15_the_future_of_transport_in_an_ageing_society.pdf (page 10)
[340] House of Commons Briefing Paper (2018, October) Access to transport for disabled people, Number CBP 601 (https://researchbriefings.files.parliament.uk/documents/SN00601/SN00601.pdf)
[341] DEFRA UK AIR, Air Information Resource, Effects of air pollution (https://uk-air.defra.gov.uk/air-pollution/effects)
[342] Asthma UK (https://www.asthma.org.uk/advice/triggers/pollution/)
[343] Munzel T, Schmidt FP, Steven S, Herzog J, Daiber A, Sorensen M. Environmental Noise and the Cardiovascular System. J Am Coll Cardiol. 2018;71(6):688-97 (Extract from Journal of the American College of Cardiology 2018; http://www.intuition-physician.com/wp-content/uploads/2018/05/Evironmental-Noise-and-Cardiovascular-Health.pdf)
[344] Department for Transport (2012) Transport for everyone: an action plan to promote equality. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/36211/equality-action-plan.pdf (Accessed: 7 May 2019).
[345] Department for Transport (2017) Annual bus statistics 2016/17 (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/666759/annual-bus-statistics-year-ending-march-2017.pdf)
[346] Department for Transport (2012) Transport for everyone: an action plan to promote equality (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/36211/equality-action-plan.pdf)
[347] Department for Transport (2018, January) Walking and Cycling Statistics, England: 2016 (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/674503/walking-and-cycling-statistics-england-2016.pdf)

Sensitive sub-group	Location	Justification
no car, unemployment)	stops, community facilities	own a car, and their lack of transport options may limit life and work opportunities[348]. People living in deprived areas tend to suffer the most from road traffic incidents (deaths and injuries), noise and air pollution, as they tend to be characterised by high traffic volume[349] as well as other environmental burdens such as industrial facilities. This group is generally more likely to already have reduced access to health and social care[350] as well as reduced access to other services and amenities. This group may have increased stress levels due to the factors above. The highway environment can also include degradation through litter, graffiti, contributing to a poor physical environment which acts as a barrier to active travel. In addition, this group is more sensitive to food insecurity[351], which has an access dimension.

Table Source: adapted from IEMA 2017

Health determinants

13.5.35 Following IEMA guidance on the UK public health profession's 'wider determinants of health' Wider Groups model[352], this assessment considers human health to be underpinned by a number of health determinants encompassed in several environmental, social and economic aspects considered relevant to a road scheme which are illustrated in Table 13.10.

Table 13.10:: Health determinants scoped in for assessment

Aspect	Health determinants
Natural environment	Air pollution
Built environment	Risk of injuries and death Soil and water pollution
Activities	Access to housing, education, health care services and other social infrastructure
Local economy	Access to work and training
Lifestyle	Noise pollution and vibration

Health baseline and community health profile

13.5.36 The baseline and community health profile in Section 13.7 has been established from analysis of local socio-economic, demographic and health data in comparison with sub-regional and national data and review of health strategies. It provides an understanding of the health determinants and receptors in the

[348] Sheffield Hallam University - Centre for Regional Economic and Social Research (2017, June) Addressing transport barriers to work in low income neighbourhoods (https://www4.shu.ac.uk/research/cresr/sites/shu.ac.uk/files/jrf-addressing-transport-barriers.pdf)
[349] Springer (2009, June) Understanding patterns of deprivation (https://link.springer.com/article/10.1057/rt.2009.7)
[350] Cookson. R, Propper. C, Asaria. M, Raine. R (2016) Socio-economic Inequalities in Health Care in England (source: Wiley Online Library, https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1475-5890.2016.12109)
[351] FRAC Food Research & Action Center (http://frac.org/obesity-health/low-income-food-insecure-people-vulnerable-poor-nutrition-obesity)
[352] IEMA (2017) Health in Environmental Impact Assessment 'A Primer for a Proportionate Approach' p.6 (https://www.iema.net/assets/newbuild/documents/IEMA%20Primer%20on%20Health%20in%20UK%20EIA%20Doc%20V11.pdf)

study area, particularly the presence of any sensitive groups which may be more vulnerable or susceptible to potential impacts. It covers the following aspects:

- Demographic and socio-economic: demographic change, age, employment, economy, and education;
- Health: health and wellbeing status, health and social care provision;
- Quality of life: deprivation, social capital and community cohesion, crime and safety; and
- Natural and built environment: buildings, transport and connectivity, local amenities and facilities.

Sensitivity of the receptors

13.5.37 The potential effects of the Scheme on physical and mental health, and the social wellbeing of local population groups, depends on the receptors' sensitivity to changes to the wider health determinants identified in Table 13.11. The assessment has involved a review of evidence on pathways for the transmission of changes in health determinants to the health of population groups, including sensitive groups, grounded in the baseline health context, to assign each receptor a sensitivity value with respect to each determinant, in line with the criteria in Table 13.3.

13.5.38 Based on this sensitivity criteria (Table 13.3), Table 13.12 sets out the indicative sensitivity of receptors within this assessment.

13.5.39 Sensitivity of human health receptors depends on whether the receptor is likely to be directly affected by changes to health determinants caused by the Scheme and whether the receptor is well placed to deal with impacts.

13.5.40 The health determinants relevant to the Scheme are included in Table 13.10. The health receptor sensitivity to these health determinants is included in Table 13.12.

Table 13.11: **Pathways of impact to human health**

Health determinant	Impact to health, including to sensitive groups
Air pollution	Poor environmental quality and exposure to waste is linked to increased risk for physical health, including respiratory and gastrointestinal problems, and lower mental health outcomes. Those with existing health issues are likely to be more sensitive. Asthma, allergies and some types of cancer are of particular concern to children.[353]
Risk of injuries and death	An individual's risk of injury may be impacted by many social, personal, economic and environmental factors. The physical environment such as transport systems and infrastructure, land use and urban development can affect the rate of incidents, injuries and death.

[353] WHO Ambient air pollution: Health impacts (https://www.who.int/airpollution/ambient/health-impacts/en/)

Health determinant	Impact to health, including to sensitive groups
	Road traffic injuries are a major public health issue[354][355], particularly in the study area[356] [357] [358]. Injuries resulting from motor vehicle accidents are the leading cause of death for young people[359].
Soil and water pollution	Soil and water pollution can lead to public health impacts directly when people encounter water and soil through recreation activities and or indirectly through the use of water for gardens and allotments watering.
Access to housing, education, healthcare services and other social infrastructure	Social infrastructure covers a range of services and facilities that meet local and strategic needs and contribute towards a good quality of life. Housing is not just a dwelling place. It provides comfort, shelter, safety and warmth. It provides the main setting for our health throughout our lives. Good housing and physical and financial access to housing can play its part in reducing health inequalities and health harms[360]. Education plays a major role in a person's overall health and wellbeing[361]. Education can affect us throughout our lifetime and has been shown to increase healthy behaviours and improve health outcomes, including obesity rates. Early education is especially important because it sets the foundation for a healthy life. Availability and use of healthcare services that prevent and treat disease and other social infrastructure is important for promoting and maintaining health, preventing and treating disease, reducing unnecessary disability and premature death, and achieving health equality for the population[362]. Groups more sensitive to illness, such as the elderly and children, benefit disproportionately.
Access to work and training	Income and work are two of the most important determinants of health and wellbeing[363] [364]. Employment and skills influence mental and physical health, with low education levels and unemployment linked with increased stress, lower self-confidence, increased rates of illness and premature death. Those on lower incomes due to low skills or unemployment are also less likely to be able to engage in healthy behaviours which impact physical and mental health.
Noise pollution and vibration	Noise is linked to potential negative effects on physical, social and mental wellbeing[365][366]. Potential health effects identified include hearing loss or loss of hearing sensitivity, sleep disturbance, cardiovascular and physiological effects, mental health effects and behavioural effects, including poor school performance by school children.

[354] WHO Road traffic injuries (https://www.who.int/violence_injury_prevention/road_traffic/en/)
[355] WHO (2018) Road traffic injuries – Key facts (https://www.who.int/en/news-room/fact-sheets/detail/road-traffic-injuries)
[356] Public Health England (2018) Local authority profiles 2018 (https://fingertips.phe.org.uk/profile/health-profiles/area-search-results/E12000008?search_type=list-child-areas&place_name=South East)
[357] Highways England https://highwaysengland.co.uk/projects/m2-junction-5-improvements/
[358] IMD 2015
[359] WHO (2018) Global status report on road safety 2018 (https://www.who.int/violence_injury_prevention/road_safety_status/2018/en/)
[360] Housing LIN Practice Brief (2016) Closing the health gap – a gap worth closing: How housing can play its part in reducing health inequalities (https://www.housinglin.org.uk/_assets/Resources/Housing/Support_materials/Practice_briefings/HLIN_PracticeBriefing_HealthInequalities.pdf)
[361] Economic and Social Research Council (2014) The wellbeing effect of education (https://esrc.ukri.org/news-events-and-publications/evidence-briefings/the-wellbeing-effect-of-education/)
[362] Evans. D. B, Hsu. J, Boerma. T (2013) Universal health coverage and universal access, cited in WHO (https://www.who.int/bulletin/volumes/91/8/13-125450/en/)
[363] WHO The determinants of health (https://www.who.int/hia/evidence/doh/en/)
[364] Joseph Rowntree Foundation Report (2014) How does money influence health? (https://www.jrf.org.uk/sites/default/files/jrf/migrated/files/income-health-poverty-full.pdf)
[365] WHO Noise (http://www.euro.who.int/en/health-topics/environment-and-health/noise/noise)
[366] WHO Noise (https://www.who.int/sustainable-development/transport/health-risks/noise/en/)

Table 13.12: Health receptor sensitivity to health determinants

Health receptor	Determinant and sensitivity
Local population overall	– Air pollution – High – Risk of injuries and death – Medium – Soil and water pollution – Medium – Access to housing, education, health care services and other social infrastructure – Medium – Access to work and training – High – Noise pollution and vibration – High
Families with children and adolescents – sensitive group	– Air pollution – Very High – Risk of injuries and death – Very High – Soil and water pollution – High – Access to housing, education, health care services and other social infrastructure – High – Access to work and training – Low – Noise pollution and vibration – High
People from certain ethnicity groups and/or gender – sensitive group	– Air pollution – High – Risk of injuries and death – High – Soil and water pollution – Medium – Access to housing, education, health care services and other social infrastructure – High – Access to work and training – High – Noise pollution and vibration – High
People who are physically or mentally disadvantaged – sensitive group	– Air pollution – Very High – Risk of injuries and death – Very High – Soil and water pollution – High – Access to housing, education, health care services and other social infrastructure – High – Access to work and training – High – Noise pollution and vibration – High
People who are materially disadvantaged – sensitive group	– Air pollution – High – Risk of injuries and death – Medium – Soil and water pollution – Medium – Access to housing, education, health care services and other social infrastructure – High – Access to work and training – High – Noise pollution and vibration – High

Impact magnitude

13.5.41 Identification and assessment of the health determinants affected by the Scheme (e.g. air pollution, noise pollution, soil and water pollution) has drawn upon the health baseline for the study area and residual effects identified in other relevant chapter topic assessments for the Scheme (e.g. Air Quality (Chapter 5), Noise and Vibration (Chapter 6), Road Drainage and the Water Environment

(Chapter 8), and Geology and Soils (Chapter 10)). The reported changes to wider health determinants are therefore inclusive of cumulative effects and any mitigation measures identified in the topic assessments.

13.5.42 However, the determinants of risk of injuries and death, access to housing, education, health care services and other social infrastructure, and access to work and training are not covered by other topic assessments. Professional judgement, informed by the description and scope of the Scheme, has therefore been used to assess the level of change to these determinants.

13.5.43 The likely magnitude of impact of the changes to the health determinants on human health has been assessed according to the criteria in Table 13.13 below. Impact magnitude also considers the direction of change (beneficial/adverse), scheme stage (construction/operation) and where relevant, any impacts on sensitive groups. For consistency, the criteria closely match those used in assessment of the other environmental impacts of the Scheme.

Table 13.13: **Impact criteria for changes to human health**

Magnitude	Description of impact
Major	– Permanent impact to the health determinant – Impact affecting large number of people – Impact affects sensitive population groups
Moderate	– Long-term impact (over a year) to the health determinant – Impact affecting moderate number of people – Impact affects some sensitive population groups
Minor	– Short-term, temporary impact (several months) to the health determinant – Impact affecting low-moderate number of people – Impact affects few sensitive population groups
Negligible	– No or non-perceptible impact to the health determinant or to sensitive groups

Table Source: Atkins own methodology 2018

Reporting of significance

13.5.44 The level of significance is the product of the sensitivity of receptors and magnitude of impact. The significance of effects within this assessment will be measured according to the significance of effect matrix set out in Table 13.14. Significance of effects can be neutral, beneficial or adverse and is informed by considerations of permanence of effect (temporary or permanent), type of effect (direct or indirect) and duration of effect (short-term or long-term).

Table 13.14: Significance of effect matrix

		Magnitude of impact/risk				
		No change	**Negligible**	**Minor**	**Moderate**	**Major**
Receptor sensitivity	**Very high**	Neutral	Slight	Moderate or large	Large or very large	Very Large
	High	Neutral	Slight	Moderate or slight	Moderate or large	Large or very large
	Medium	Neutral	Neutral or slight	Slight	Moderate	Moderate or large
	Low	Neutral	Neutral or slight	Neutral or slight	Slight	Moderate or slight
	Negligible	Neutral	Neutral	Neutral or Slight	Neutral or Slight	Slight

Table source: DMRB Volume 11, Section 2, Part 5 HA 205/08

Table 13.15: Descriptors of the significance of effect changes

Significance category	Typical descriptors of effect
Very large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Large	These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process.
Moderate	These beneficial or adverse effects may be important but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.
Slight	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process but are important in enhancing the subsequent design of the project.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Table Source: From Highways England DMRB, Volume 11, Section 2, Part 5, Table 2.3

13.5.45 Using the described classification (Tables 13.14 and 13.15) and professional judgement, effects considered to be Very Large, Large or Moderate are deemed significant and those Slight, or Neutral, to be not significant, for the purposes of this assessment, following the EIA Regulations.

Vehicle travellers

13.5.46 Using professional judgement and experience on other highways schemes, the sensitivity of vehicle travellers (i.e. users of main roads or passengers in public transport on main arterial routes) has been assigned as Low, as vehicle travellers are considered to be able to accommodate change to current baseline conditions.

View from the road

13.5.47 The assessment of vehicle travellers' views has been based on the guidance in DMRB Volume 11, Part 3, Chapter 9. 'View from the road' is taken to be the extent to which travellers, including drivers, are exposed to the different types of scenery through which a route passes. Aspects to be considered are:

- The types of scenery or the landscape character;
- The quality of the landscape;
- Features of particular interest or prominence in the view; and
- The extent to which travellers may be able to view the scene.

13.5.48 In defining sensitivity, the extent to which travellers may be able to view the landscape has been assessed according to the following categories:

- No view: road in steep cutting or contained by earth bunds, environmental barriers or adjacent structures;
- Restricted view: frequent cuttings or structures blocking the view;
- Intermittent view: road generally at ground level with shallow cuttings or barriers at intervals; and
- Open view: view extending over many miles or only restricted by existing landscape features.

13.5.49 The effects of the Scheme on traveller's views from existing routes and the carriageway of the Scheme itself has been assessed by adapting the guidance in DMRB Volume 11, Section 3, Part 9, Chapter 2, using professional judgement and best practice, and consideration of the TAG unit A4.1 Social Impact Appraisal guidance, shown in Table 13.16.

Table 13.16: **Assessment criteria for views from the road for vehicle travellers**

Magnitude	Magnitude of impact criteria
Beneficial	Views from the road would be, on balance, a change for the better.
Neutral /Negligible	Little or no effect for most views from the road or improvements on some views are generally balanced by deterioration in others.
Adverse	Views from the road would be, on balance, a change for the worse.

Table Source: adapted from DMRB Volume 11, Section 3, Part 9, Chapter 2

Driver stress

13.5.50 There are three main components of driver stress: frustration; fear of potential accidents; and uncertainty relating to the route being followed:

- Driver frustration – caused by an inability to drive at a speed consistent with the standard of the road and this increases as speed falls in relation to expectations;
- Driver fear – the main factors are the presence of other vehicles, inadequate sight distances, and the likelihood of pedestrians, particularly children and adolescents, stepping into the road. Fear is highest when

speeds, flows and the proportion of heavy vehicles are all high, becoming more important in adverse weather conditions; and

- Driver uncertainty – caused primarily by signing that is inadequate for the individual's purposes.

13.5.51 The measurable aspect of driver stress is associated with frustration due to delays. Therefore, the level of driver stress has been determined through a qualitative assessment of the above factors under the finely graded three-point descriptive scale, Low, Moderate or High, as recommended by DMRB Volume 11, Section 3, Part 9.

13.6 Assumptions and limitations

13.6.1 The assessment of effects on population and human health is based on guidance and professional judgement and considers both the adverse and beneficial impacts that the Scheme could have on receptors.

13.6.2 It will provide an assessment of likely effects on population and human health based on a proportionate assessment. Whilst it will be possible to identify changes to some of the determinants of health likely to arise from the Scheme, health outcomes are dependent on multiple factors, some of which rest with individuals and/or outside the powers or influence of physical infrastructure and/or planning decisions. Identifying health effects of the Scheme and their significance will therefore be a qualitative exercise. The findings are based upon a desk-based study of the area, along with consultants' professional judgement and knowledge based on previous similar schemes. Information, where relevant, is also used from other specialist topic assessments to help assess the significance of effects of the Scheme on receptors.

13.6.3 In the absence of prescriptive Highways England or DMRB guidance for population and human health assessment study areas, the likely effects for population and human health will be assessed within the core and wider study areas outlined in section 13.4. Whilst this creates overlap and uncertainty, it is considered that these study areas will capture the most relevant population and human health impacts.

13.6.4 The health assessment section of this chapter is by nature a cumulative assessment, which considers the population and human health impacts of all environmental effects of the Scheme. Therefore, there will be a degree of overlap between this chapter, the Equality Impact Screening and Assessment (EISA) and the other technical chapters of the ES (notably Air Quality (Chapter 5), Noise and Vibration (Chapter 6), Road Drainage and The Water Environment (Chapter 8), and Landscape and Visual (Chapter 9)) that will also be summarised in the Assessment of Cumulative Effects (Chapter 15).

13.7 Baseline conditions

13.7.1 The baseline follows published guidance provided in IAN 125/15 and other Highways England guidance to inform the assessment of the sensitivity of receptors and health determinants in the study area, particularly the presence of any sensitive groups which may be more susceptible or vulnerable to impacts.

13.7.2 The baseline conditions have been updated since the preparation of the Environmental Scoping Report (October 2018) through further desktop research to better reflect the characteristics of the core and wider study area, differentiate between population and human health baseline information, and avoid duplication. The human health baseline itself focuses on the public health profile for the wider study area, including demographic profile, demographic trends, socio-economic profile, deprivation, health and wellbeing characteristics, and general characteristics of the natural and built environment.

13.7.3 The key characteristics are presented in Table 13.17, with a more detailed baseline provided in Appendix I in Volume 2.

Table 13.17: Population and human health baseline

Receptor type	Notes
Population	
Private dwellings	There are a number of private dwellings in the core and wider study areas, principally located in the main settlement of Sittingbourne and the smaller local villages of Danaway, Stockbury, Borden, Oad Street, Newington and South Green. There are 3,912 households within the Core Study Area. The closest private dwellings to the Scheme include The Gate House, Coach House, Vale Cottages and Vale House (within 50 m of the A249 southbound carriageway), Threeways, Woolpit Ash and Whipstakes Farm, Stockbury Valley (within 5 0m of Pett Lane, 150-350 m south of Oad Street); Milton Bungalow and Bowl Reed (within 30 m of Oad Street) and Applegate Farm (250 m north of Oad Street) and to a lesser extent - Stonefield, Orchards, Woodgate Far, Westgate Cottage and Woodgate (50-275 m north of Oad Street); several residential dwellings to the north side of Maidstone Road and a small number to the south side of Maidstone Road (all within 150 m of Maidstone Road, to the east of the proposed '2 lane exit slip road' and north of the proposed 'New Maidstone Road link'); and White House and Valley View Farm (both within 250 m of the A249 southbound carriageway). 293 of these households are occupied by lone parent families, and 407 are one-person households, aged 65 and over. In the wider study area, there are 119,032 households in Swale and Maidstone. There are 273,381 households in the local authority areas for Swale, Maidstone, Medway, and Tonbridge and Malling. The percentage of one-person households aged 65 and over in Swale and Maidstone is 12%. The percentage of lone parent households in Swale and Maidstone is 11% and 10%, respectively.
Community land and facilities	St Mary Magdalene Church (Church Hill, Stockbury) and Sittingbourne & Milton Regis Golf Club, located to the south and north of M2 J5 respectively are both within the core study area, 250m from the A249 northbound carriageway. Just outside the core study area is the Outdoor Pursuits and Quad Nation centre at Wormdale Farm. Land to the south of the M2 westbound carriageway is within the Kent Downs AONB, which is used for leisure-based activities. In the wider study area there are a small number of community facilities in Harrow, Stockbury, including a village hall/Sittingbourne Town Football Club; a chapel and craft centre/café in Oad Street, and; a large number of community facilities in the larger settlement of Sittingbourne, including places of worship, rail links, shops, several schools, care/nursing homes, post offices, leisure centre, parks, medical facilities, and go-kart circuit. The nearest large settlement is Sittingbourne, which is located approximately 5 km northeast of M2 Junction 5. Sittingbourne is a large town with a population of approximately 62,500 people. Due to its size, it contains many community facilities such as shops, places of worship, a rail link, a number of infant, primary and secondary schools, post offices, and other community assets such as a leisure centre, parks, pharmacies, and a go-kart circuit. There are no schools or nurseries within the core study areas. The nearest primary schools and pre-schools are 2 km and 2.2 km to the east and west in Borden and Hartlip, respectively. The nearest secondary school is Westlands School in Sittingbourne, 3.6 km to the northeast.

Receptor type	Notes
	There are no care/nursing homes in the core study area. The nearest care/nursing home is Hengist Field Care Cantre, located approximately 2 km to the east of M2 J5. There are a number of care/nursing homes more than 3 km away in Sittingbourne and along the A2 corridor. There are no GP's clinics, dentists or hospitals within the core study area. The nearest facilities are approximately 2.75 km away in Sittingbourne. There doesn't appear to be any areas of designated public open space within the core area, or LAP, LEAP or NEAP play areas. There is a tennis court/football pitch at Bowl Reed, Oad Street, 50m east of the Oad Street carriageway and 15m north of the M2 southbound carriageway. Bus services in Sittingbourne facilitate journeys between Sittingbourne, London, the wider South East of England and beyond. Bus services in Newington provide connections with other communities in London, South East England and beyond. There are four bus stops situated within the study area. Two of these are located on either side of the A249, approximately 60 m south of the intersection of Oad Street and the A249. Two others are located on either side of Maidstone Road approximately 800 m north of M2 Junction 5. In terms of community accessibility, journeys are likely to take place to and from Sittingbourne in order to access its facilities from the surrounding communities (including for education, recreation and employment). In addition, residents and employees will access the rural communities within the Kent Downs AONB for leisure-based activities. Kent Downs AONB covers an extensive area to the south of the majority of the M2 eastbound carriageway.
Rural enterprises	There are several farmsteads within 500m of the Scheme: Squirrels Farm, Rumstead Lane, ME9 7QJ (500 m south of Scheme, immediately south of A249); Squirrel Farm, Stockbury ME9 7QH (275 m south of the Scheme, south of A249); Hillside Farm, Stockbury Valley ME9 7QH (immediately south of Scheme, south of A249); Valley View Farm, Stockbury Valley ME9 7QD (70 m south of A249); Church Farm, Church Lane Stockbury ME9 7RD (350 m north of A249); Burden Bros Agri Ltd (Church Lane, ME9 7RD) (400 m north of A249); Norton Green Farm, Sittingbourne ME9 7RN (500 m south of A249); Whipstakes Farm, Stockbury Valley ME9 7QJ (50 m south of Oad Street, 250 m east of A249 roundabout); Baden Stables and Stud, Oad Street ME9 8JX (immediately north of Oad Street); Applegate Farm, Oad Street, Borden ME9 8JX (150 m north of Oad Street); Pebble Court Farm, Woodgate Lane, Borden ME9 7QB (200 m south of Maidstone Road); Wormdale Farm, Wormdale Hill Newington ME9 7PX (400 m north of A249); Eyehorn Farm, Munsgore Lane, Borden ME9 8JU (500 m south of A249); E.J. Mackelden & Sons (Bobbing) Limited (north of area); Thrognall Farm, Newington ME9 7SJ.

Receptor type	Notes
Local businesses	There are a range of local businesses in the core study area. Businesses located close to the Scheme include Gleneagles Garage, Danaway WSW, Glass Constructions (all on Maidstone Road within 150 m of the Scheme), Stockbury Boarding Kennels (within 50m of the A249 southbound carriageway, off Sittingbourne Road), Burden Bros Agri Ltd (Church Lane, 400 m north of the A249 northbound carriageway), Willows Studio, Roydens Ltd (100 m south of the A249 southbound carriageway, Hayes Lane), Kingsford E J Riding School (500 m south of the A249 southbound carriageway, Norton Green), Sittingbourne & Milton Regis Golf Club and Quad Nation (300-450 m north of the A249 northbound carriageway). John Best Racing and Equiprofi Ltd equestrian centre (Eyehorn Farm) are just outside the core study area, within 700 m of the Scheme. In the wider area, businesses in the surrounding settlements such as Sittingbourne, Maidstone, Isle of Sheppey, Port of Sheerness, and further afield Gillingham, Chatham, Rochester, Faversham and the catchment area of Port of Dover are likely to be affected by the Scheme. There is also a horse stud and stables in the core study area. The scheme itself is not located within an area designated for development under the Swale Borough or Maidstone Borough Council's Local Plans. However, the Scheme is seen as important infrastructure in unlocking the housing and employment growth ambitions for Swale Borough Council and the economic potential of the wider area, as outlined in the [South East] Local Economic Partnership Economic Plan and Kent Corridors to M25 Route Strategy Evidence Report (Highways England, 2014). There are two significant permitted planning applications within 10 km of the Scheme: 1) Wheelabrator Kemsley Generating Station (K3) Power Upgrade: Change to Kemsley Generating Station incorporating power upgrade up to 75 MW. The application is expected to be submitted to the Planning Inspectorate Q2/Q3 2018. PINS produced a scoping opinion in January 2017; and 2) Kemsley Paper Mill (K4) CHP Plant: A Combined Heat and Power Plant comprising a gas turbine (52 MW), Waste Heat Recovery Boilers (105 MWth steam) and Steam Turbine (16 MW). An application for the above project was received by the Planning Inspectorate from DS Smith Paper Ltd in February 2018.
Non-motorised users	There are several PRoW which connect or interact with the M2 and A249 in the core study area, allowing pedestrians, cyclists and equestrians travelling between the villages of Danaway, Stockbury and Lower Hartlip, in particular to cross the M2, Junction 5. The key PRoW includes: • ZR71 – a footpath connecting Wormdale Hill Road outside Danaway and Bull Lane in Hartlip, running parallel to the north of the M2 westbound carriageway, and immediately to the west of the A249 northbound carriageway. • ZR73/1 – a byway open to all traffic (Woodgate Lane), running generally southeast to northwest from Oad Street to Maidstone Road to the south of the village of Danaway. • KH85/2 – a footpath running northwards from the western side of the A249 northbound exit slip road to M2, Junction 5, through open countryside and Church Wood, connecting with KH653/2 to the south of the M2 eastbound carriageway and footpath ZR70. The footpath is considered as a dead end as it does not include a safe crossing point on the A249.

Receptor type	Notes
	• ZR70 – a footpath running southwards from ZR71, crossing the M2 motorway just to the west of M2 Junction 5, connecting to footpath KH85 and BOAT KH653/2 to the north of Church Wood. • Unnamed footpath, connecting to footpath KH81 further to the west, running north eastwards from Honeycrock Hill, running parallel (within 10 metres) to the northbound carriageway of the A249, terminating at the bus stop adjacent to the A249 northbound carriageway, approximately 275 m south of M2, Junction 5. • Unnamed footpath, running north-eastwards from north of Vale House/Vale Cottages, running parallel to the A249 southbound carriageway (within 10 m), connecting to the bus stop on the A249 southbound carriageway, located approximately 275 m to the south of M2, Junction 5. Other PRoWs intersect and are adjacent to sections of the Scheme within the study area. This includes a network of footpaths and bridleways which allow communities to travel between the villages of Danaway, Stockbury and Lower Harlip. No National Cycle Routes are located within, or close to, the study area however, there is one local route on Maidstone Road which terminates at the M2 Junction 5. There are four bus stops within the Scheme area. Two of these are located on either side of the A249, approximately 60 m south of where Oad Street meets the A249. Two others are located on either side of Maidstone Road approximately 800 m north of the M2 Junction 5.
Human health (overall profiles)	
Public health profile (refer to Appendix I, Volume 2)	Demographic Profile: The M2 serves a population for Maidstone, Swale, Tonbridge and Malling local authorities, and the unitary authority area of Medway of 717,195 (Revised 2012-2016 mid-year population estimates released 22 March 2018[367]). General Health: Public Health The general health of residents in Swale and Medway is worse than the England average. The general health of residents in Maidstone, and Tonbridge and Malling, is better than the England average[368]. The proportion of residents in Swale with very bad health and bad health is above the England average and significantly above the South East LEP average. This reflects the health inequalities that exist in Swale, caused by people living in areas of high deprivation[24]. Limiting long-term illness or disability is less prevalent in Medway, Maidstone, and Tonbridge and Malling, compared to that of the England average. Long-term limiting illness is more prevalent in Swale than the England average[24].

[367] ONS 2018
[368] NOMIS 2018

Receptor type	Notes
	Mortality rates overall from cardiovascular disease for Tonbridge and Malling, Maidstone and Swale is less than the average for England. Mortality rates in Medway is identical to the England average[24]. One of the key priorities for the Kent Joint Health and Wellbeing Strategy is a reduction in the under-75 mortality rate from cardiovascular disease (rate per 100,000). Coronary heart disease (CHD) and chronic obstructive pulmonary disease (COPD) are reported as the top two causes of preventable deaths in the Swale area[369]. Social Wellbeing: The mental health admission rate for Medway is similar to the average for England and the South East (Kent, Surrey and Sussex). Mental health admissions for Swale CCG and West Kent CCG are lower than the England average. Amongst the main causes of death for people with a mental health condition are cardiovascular disease, cancer and pulmonary disease. Those affected by these conditions die 20 years earlier than a person with no mental illness on average[370]. Road Casualties: The M2 Junction 5 is one of the top 50 national casualty locations on England's major 'A' roads and motorways, and one of the main areas within the Kent Corridors to M25 Route Strategy Evidence Report which interacts with vulnerable road users. There were 111 personal injury accidents recorded between January 2011 and December 2015, with almost half of these occurring during the morning and evening peak periods[371]. Collision data obtained from Kent County Council for the period between 1 October 2009 and 31 September 2014 indicates that there were 92 collisions reported immediately around the M2 Junction 5, 88 being categorised as slight collisions and four being categorised as serious collisions[372].
Economic profile	Level of Deprivation: Swale has relatively high levels of deprivation, ranked 77th out of 326 local authorities in the 2015 IMD. One third of neighbourhoods in Kent that fall within the 10% most deprived in England are within Swale. Around 24% of children in Swale live in child poverty[373]. Deprivation generally, has increased in Swale, Maidstone and Medway (IMD2015 and IMD2010 comparison). By contrast, Tonbridge and Malling is currently one of the 20% least deprived districts/unitary authorities in England and has improved since IMD2010[374]. Socio-Economic:

[369] Kent Joint Health and Wellbeing Strategy
[370] Kent Joint Health and Wellbeing Strategy
[371] Highways England https://highwaysengland.co.uk/projects/m2-junction-5-improvements/
[372] Highways England - M2 Junction 5 Improvement Study Regional Investment Programme, PCF Stage 1 Report 2016
[373] IMD 2015
[374] IMD 2015/IMD 2010

Receptor type	Notes
	Medway has a higher unemployment rate, compared to the average for England, Kent and the South East LEP. Unemployment rates in Swale and Maidstone are below the England average. The unemployment rate in Tonbridge and Malling is below the England average and Kent average[26]. Between May 2017 and May 2018, there was a significant increase in unemployment in Swale, and minor increases in unemployment in Tonbridge and Malling and Medway. Over the same period, there was a decrease in unemployment in Maidstone. Youth unemployment (ages 18-24) is relatively high in Swale compared to that of Kent and the other local authority areas affected by the Scheme[26]. The proportion of residents of working age claiming benefits in Swale and Medway are both higher than the average for England, Kent and South East LEP. The proportion of residents of working age claiming benefits in Maidstone and Tonbridge and Malling is lower than the average for England[26]. The proportion of residents claiming ESA and incapacity benefits in Swale is also higher than the England average. The proportion of residents claiming ESA and incapacity benefits in Tonbridge and Malling and Maidstone are lower than the average for England[26]. The number of lone parents and carers in Swale and Medway are higher than the average for England. The number of disabled claimants is also higher in Swale and Medway than the average for England[26]. Economic Activity: The economic activity rate for Kent is higher than for England but lower than the South East. The economic activity rates for Maidstone and Medway are above the average for England; the economic activity rates for Tonbridge and Malling, and Swale are below the average for England[26]. Business sectors: Swale has a higher share of its businesses in manufacturing (6%), construction (17%), and transport and storage (6%) than the nation level as shown in Table I.19 in Appendix I, Volume 2. Maidstone (15%), Tonbridge and Malling (14%) and Medway (18%) also have higher percentages in construction. The share of businesses in the retail sector are consistent across all areas[26]. Occupations and Skills: Tonbridge and Malling, Swale and Medway all have a lower percentage of its population working in Standard Occupation Classification (SOC) 1-3 job roles (managerial, technical and professional) than that of the South East. Employment in these areas is more concentrated in skilled trades. For example, Swale (14.4%) and Medway (15.6%) both have significantly higher concentrations in the skilled trade sectors relative to that for England (10.2%). Swale also has a significantly higher employment in processing, plant and machine operatives (11.7%) compared to England (6.2%). This reflects the share of Swale's (i.e. Sittingbourne) economy that is focused on processing goods which come to/from Dover and are transported throughout the rest of the UK. Kent and the four local authorities all have a lower percentage with qualification level National Vocational Qualifications (NVQ) 4 or above than England, with Swale being the lowest percentage[26].

Receptor type	Notes
	Salary Income: Residents of Maidstone (£26,519), and Tonbridge and Malling (£28,710) both have higher average annual incomes than England (£25,604). Swale (£22,125) and Medway (£23,951) both have lower average annual residential incomes than England. The average annual workplace incomes for all of the local authorities and Kent (£31,890) is lower than that of England (£36,107), with Swale being particularly low again at £28,651[23]. The differentials in wages is likely the result of dominant employment types and sectors. Furthermore, the large differential in Maidstone, and Tonbridge and Malling's residential wages over workplace wages may reflect a significant proportion of the resident population that commute into London to occupy higher paying jobs. Travel to Work: The average distance travelled within all the local authorities and South East England is significantly higher than that of England on a whole. Notably, Swale has a particularly high travel to work distance of 19.5 km. As shown in Table I.16 in Appendix I Volume 2 the majority of the population of Swale and Maidstone work locally or in the surrounding area. Medway and Tonbridge & Malling have a significant proportion of their population commuting to London. Table I.17 also indicates that all the local authorities, in particular Swale and Medway, have a high level of private road commuters for those residents working within the study area[375]. Household car availability: As shown in Table J.16 in Appendix I Volume 2, all of the local authorities have a higher percentage of their population owning cars than the average for England, with Maidstone and Tonbridge and Malling having the highest car ownership levels[26].
Vehicle travellers	View from the Road: The M2 enables the main flow of traffic, broadly east-west within the study area. The A249 runs broadly south to north within the study area. The study area contains varying degrees of screening elements. Views from eastbound on the M2 and approaching M2 Junction 5 provides a mix of restricted and intermittent views of arable land within the Kent Downs AONB. Views are restricted by mature trees, verges and other material as the M2 Junction 5 nears. Open views are available on both the northern and southern sides of the road of arable land, wooded areas and large areas of the Kent Downs AONB. Views become restricted through wooded areas adjacent to the highway and verges after the M2 crosses the A249. The majority of existing link roads which connect the M2 to the A249 have restricted views from road side vegetation, with occasional intermittent views of arable land and wooded areas. Driver Stress:

[375] Census 2011

Receptor type	Notes
	The M2 carries high volumes of traffic which can cause disruption and delays to the surrounding road network, particularly when emergency closures and lane closures are imposed. Congestion is greatest during the peak am and pm periods, which results in poor journey time reliability. Highways England initiated a 'Route Based Strategy' sifting process in the Kent Corridor to M25 Route Strategy Evidence Report, with Stage 1 examining congestion and safety issues along the Kent Corridors to M25 routes. The Report found that the approach to the junction from the east (between the M2 Junction 5 and the M2 Junction 6) has the highest level of vehicle hours delays. Congestion also affects the A249 southbound between Sittingbourne and the M2 Junction 5, where average peak hours are below the speed limit. M2 Junction 5 was one of the 50 national casualty locations and one of the main areas within the Kent Corridors to M25 study route that interacts with sensitive or vulnerable road users. In total there was 33 collisions with the highest severity rating between 2009 and 2011. According to collision data from Kent County Council, between the 1 October 2009 and 31 September 2014, 92 collisions have been reported around M2 Junction 5. 4 were categorised as serious collisions and 88 categorised as slight collisions.

13.8 Potential impacts

Context

13.8.1 Using professional judgement, the population and human health baseline in Table 13.17, the wider human health baseline in Appendix I in Volume 2, and Scheme information available at the time of writing, several potential impacts on population and human health have been identified for the construction and operational phases of the Scheme, as set out below. Please note that several sub-topics were scoped out in the Environmental Scoping Report (October 2018), therefore some topics have not been assessed for both the construction and operational phases.

Construction

Population

Private dwellings: land take and changes in access

13.8.2 Private dwellings and land currently falling within the curtilage of private dwellings are likely to be required for land take for construction purposes or to accommodate the Scheme. Potential changes to access arrangements and severance impacts will depend upon construction activities, haulage routes and associated diversions.

13.8.3 Notably, the following private dwellings close to the construction works could be affected by the Scheme:

- The Gate House (adjacent to the proposed new Oad Street link) Whipstakes Farmhouse, and residential properties near Oad Street;
- Milton Bungalow, Bowl Reed and Applegate Farm (to the southern extent of the proposed New Maidstone Road link) and to a lesser extent Stonefield, Orchards, Woodgate Farm, Westgate Cottage and Woodgate;
- Several residential dwellings on the north side of Maidstone Road and a small number to the south side of Maidstone Road; and
- White House and Valley View farm (to the south of the proposed new A249 carriageway).

Community land and facilities: changes in access

13.8.4 There are no sensitive and essential community facilities such as health centres, educational facilities or care homes within the core study area itself. However, construction of the Scheme has the potential to cause increased delays which could have a temporary adverse impact on accessibility and connectivity to community land and facilities near the Scheme. Potential severance impacts will depend on construction activities, haulage routes and associated diversions.

Rural enterprises

13.8.5 Several agricultural land holdings that operate as rural enterprises have been identified within the core study area. These are listed fully in Table 13.17. The main potential impact is likely to be severance to the farm businesses. In the construction phase there could be additional impacts of noise and dust and disruption of field drainage systems. Temporary and/or permanent changes to the spatial relationship of rural enterprises to key infrastructure and temporary changes to access could result in damage to the rural enterprises and may compromise viability.

Local businesses

13.8.6 Land currently falling within the curtilage of local businesses could be required for land take for construction purposes or to accommodate the Scheme. In particular, the proposed Maidstone Road link runs close to Baden Stables and Stud.

13.8.7 A range of local business uses (e.g. Gleneagles Garage, Danaway Water Supply Works (WSW), Glass Constructions (all on Maidstone Road), Stockbury Boarding Kennels (off Sittingbourne Road), Burden Bros Agri Ltd (Church Lane), Roydens Ltd (Hayes Lane), Kingsford E J Riding School (Norton Green)) have been identified in the core study area. Some of these businesses could be impacted by changes to amenity (e.g. noise, air quality, traffic effects) and temporary road closures and diversions, which could influence traffic flows and access, and affect trading conditions.

13.8.8 Accessibility may be highly important to certain businesses in the wider study area reliant on the transport network (e.g. logistics or distribution) or trading through Port of Dover or Peel Ports London Medway.

Non-motorised users

Changes in journey length

13.8.9 During construction, there could be a decrease or increase in journey length and/or change in travel patterns for NMU at footpaths, particularly those which interact with the M2, A249 carriageway and slip roads, and the minor road network close to the construction works.

Amenity

13.8.10 NMU within the core study area may be affected by traffic, noise, air quality and the visual intrusion of the road network within the wider environment from construction activities and construction vehicles, giving rise to impacts on amenity.

13.8.11 There could be adverse impacts on NMU during construction from changed noise and traffic levels as well as temporary and/or permanent route closures and temporary diversions.

Severance

13.8.12 Whilst changes in journey times and amenity effects are likely to be temporary and short-term, local communities may experience increased severance from community facilities.

13.8.13 In the wider study area, construction traffic associated with the Scheme has the potential to increase traffic volume, particularly heavy goods vehicle (HGV) trip numbers, in the surrounding local highway network. Diversions resulting in changes in traffic patterns and an unawareness of altered traffic movements could lead to detrimental impacts on the local community. This has potential to make road crossing more difficult, dangerous, intimidating, or time consuming, which could introduce a temporary isolation effect. Any reductions in access to local facilities would have effects on the local population.

Human health

13.8.14 The construction phase of the Scheme is anticipated to generate changes to wider health determinants.

Air pollution

13.8.15 There are only a small number of properties within the Air Quality study area (200 m). However, in the wider area there are sensitive human health receptors near the A249 and M2, which could be affected. Construction activities could have a short-term negative impact on air quality. There could be fugitive dust emissions from site works and construction vehicles carrying site materials or waste along with exhaust emissions from construction and other traffic due to road disruption and diversions.

13.8.16 Increases in outdoor air pollution can lead to increased cardiovascular and respiratory mortality and morbidity. Some effects are more immediate and can affect sensitive groups (e.g. children, people whose health is already impaired).

Risk of injuries and deaths

13.8.17 M2 Junction 5 is one of the top 50 national casualty locations on England's major 'A' roads and motorways. Over a 5-year period (January 2011 and December 2015) there were 111 personal injury accidents and nearly half occurred during am and pm peak periods[376]. Therefore, road traffic accidents are a significant cause of mortality, disability and serious injuries across various age groups. Swale borough in particular, is ranked the 77th most deprived Living Environment in England, a measure which encompasses road traffic accidents[377].

13.8.18 Increased construction traffic in the core study area, particularly in the residential areas, and alteration to existing traffic routes and patterns, could increase the risk of injuries as a result of increased traffic levels and an unawareness of altered traffic movements.

13.8.19 Sensitive road users, including motorcyclists, elderly drivers, children, pedestrians, new drivers and cyclists, may be more at risk of injury due to increased construction traffic and altered traffic movements, albeit slower vehicle movements may temporarily improve the current situation.

Soil and water pollution

13.8.20 Potential for localised contamination could occur during the construction period from construction spills and road run-off.

[376] Highways England https://highwaysengland.co.uk/projects/m2-junction-5-improvements/
[377] IMD 2015

13.8.21 The following construction phase activities may contribute to the creation of new potentially contaminated lands:

- Potential disturbance and mobilisation of contamination present within the ground;
- Creation of confined spaces, such as manholes and service chambers/ducts, within which ground gas has the potential to accumulate;
- Piling or excavation during construction could create new pathways between any contaminated soils and the underlying groundwater;
- Potential for increased run-off during earthworks with a high sediment (contamination) load; and
- Any dewatering activities (although none are expected based on existing baseline conditions) have the potential to mobilise contaminated groundwater and enhance lateral migration of contamination within the superficial and bedrock aquifers.

13.8.22 If no mitigation measures are implemented, risks could be significant. However, with mitigation measures in place, these risks can be reduced.

Access to housing, education, health care services and other social infrastructure

13.8.23 Access to services is vital, it enables good access to health care and other services, enhances opportunities for physical activity, wellbeing, participation, community interaction and social cohesion. Quality of health and community services depend on the personal factors of the physician and patient, and other factors pertaining to the location of the facility, health or community setting and the broader environment. Construction activities may cause delays and/or result in a decrease in access to local services in the wider study area, which could have temporary negative effects for health and wellbeing.

13.8.24 Accessibility is a critical component of locally-based travel, which is influenced by socio-economic activity. For example, any effects on public transport provision may disproportionately affect lower income groups and other sensitive groups and could lead to social exclusion. This can contribute negatively to quality of life and health. Specific groups include teenagers, the elderly, job seekers and people living in rural locations.

13.8.25 Car ownership amongst sensitive groups is low; between 14% and 20% of households in the local boroughs have no access to a car and rely on public transport[378], with Medway and Swale having the highest percentage. Therefore, maintaining the availability of transport options in the Scheme area is important for the wellbeing of the local community and sensitive groups.

13.8.26 Alternatively, the Scheme may lead to an increase in the provision of public transport and an improvement of the walking/cycling environment. This could lead to a reduction in car usage.

[378] NOMIS 2018

13.8.27 Changes in accessibility may lead to negative or positive impacts on physical fitness, physical health and mental wellbeing. Research shows that good quality of service is associated with lower levels of stress.

Access to work and training

13.8.28 The implementation of the Scheme has the potential to generate new employment opportunities. This would be a positive factor for health, providing financial security and contributing to self-esteem.

13.8.29 The economic benefits of construction activities in the local area will likely act to stimulate the local economy including multiplier effects. The Scheme is anticipated to stimulate access to the local job market and increase employment both through direct jobs and indirect and induced employment.

13.8.30 There may also be some adverse economic and employment impacts within the core and wider study area caused by changes or disruption to business activity and commuter times during the construction period.

13.8.31 Research shows people in employment are healthier, particularly those who have more control over their working conditions. Employment is also associated with income, a feeling of security, increased friendship networks and social status which in turn are linked to better health. These positive impacts are particularly important at a time of economic downturn for tackling its negative effects on mental health, e.g. worries caused by the fear of financial strain and job loss.

Noise pollution and vibration

13.8.32 Motorised forms of transport in the core study area are a common source of noise pollution.

13.8.33 Construction activities may lead to an increase in localised noise and vibration at sensitive residential and non-residential receptors in the core study area. This could lead to annoyance, interference with speech, and sleep disturbance.

13.8.34 Stress is a possible mechanism through which noise from the Scheme may affect mental and physical health. Evidence also suggests that noise pollution may limit children's learning. Vibration can give rise to increased stress and anxiety and sleep disturbance also.

Vehicle travellers

View from the road

13.8.35 It is anticipated that views from the road are likely to change from what is currently experienced due to the required land take, proposed new link roads, loss of vegetation screening and proposed environmental mitigation around the affected works and junctions.

13.8.36 The Scheme is likely to alter the views experienced by users of the M2, A249, Maidstone Road, Oad Street and local road network. The potential for impacts on road user amenity will be determined by the extent of existing screen planting removed to facilitate the works to the A249 and proposed new road links.

13.8.37 Whilst there may be some localised impact on a portion of the Kent Downs AONB, the proposed infrastructure is not out of character with the current situation and considered to be in keeping with the existing urbanising features associated with the M2 and A249.

Driver stress

13.8.38 Users of the M2, A249, main roads and surrounding minor road network are most likely to be affected by construction activities. It is expected that there will be some congestion or delays for communities that commute or access services nearby.

13.8.39 Driver stress is likely to increase temporarily during construction because of roadworks, albeit slower speeds will potentially create a safer environment, reducing the risk of injury or death from road traffic accidents.

Operation

Population

Private dwellings: changes in access

13.8.40 Private dwellings could suffer changes in access during operation of the Scheme, particularly from the proposed New Maidstone Road and Oad Street links, which will provide direct connectivity to M2 J5, and closure of the existing Maidstone Road slip and Honeycrock Hill junction. Private dwellings could be impacted by changes in current road access but could also benefit from reduced congestion and improved connectivity which could improve conditions for the local community and sensitive receptors.

Rural enterprises

13.8.41 Operation of the Scheme could result in severance to rural enterprises and/or changes to the spatial relationship of land to key infrastructure. It also has the potential to directly and indirectly affect rural enterprises through alterations to access and trading conditions.

Non-motorised users

13.8.42 Changes in amenity are not likely to be notable. Improved road conditions, reduced congestion and improved traffic flows will create a safer environment for communities. Changes in active travel and reduced severance because of the Scheme will potentially improve physical, mental and social wellbeing.

Human health

Air pollution

13.8.43 Road traffic in the study area is a main source of air pollution. Although the Scheme itself is not located within an Air Quality Management Area (AQMA), all three local authorities (Swale, Maidstone and Medway) have declared AQMAs within their boroughs as part of their duties under the Local Air Quality Management regime.

13.8.44 The Scheme could increase car or motor vehicle usage leading to an increase in air pollution. Alternatively, reducing congestion hot spots and creating improved traffic flow could reduce air pollution.

13.8.45 Increased efficiency of the road network could lead to an overall neutral effect on air pollution, as although vehicle usage may increase, there may be less congestion.

13.8.46 The effects of long-term exposure to changes to outdoor air pollution can lead to changes in cardiovascular and respiratory mortality and morbidity, potentially affecting various groups.

13.8.47 Similarly, a reduction in air pollution could reduce the above adverse health effects.

Risk of injuries and death

13.8.48 Road traffic accidents are a notable cause of mortality across all age groups. The Scheme has potential to implement road safety measures which could improve actual and perceived road safety.

13.8.49 There could be a reduction in traffic-related injury and death and the risk of such injury and death through changes to accident hot-spots and reduced congestion and vehicle shunts. Free flow of traffic, increased traffic numbers and higher vehicle speeds may however have adverse effects.

13.8.50 Sensitive groups are the same as those identified for the construction stage. These groups may be more prone to any changes.

Soil and water pollution

13.8.51 During the operational phase, it is anticipated that no new potentially contaminated lands (PCLs) are likely to be created. However, incidents have the potential to introduce new sources of contamination. The Outline Environmental Management Plan (OEMP) for the Scheme will address how these incidents will be managed and detail the emergency management procedures to be implemented in such an event.

13.8.52 Further details are provided in Chapter 8 of this ES.

Accessibility to housing, education, health care services and other social infrastructure

13.8.53 The accessibility of good quality housing, health and community facilities raises the quality of life, promotes healthy living and allows for the interaction and enjoyment of residents and workers.

13.8.54 Accessible and affordable transport is vital in the core study area, it enables good access to the nearby larger settlements and access to education, employment, fresh food, friends and family, leisure and health services, and enhances general physical health and wellbeing. The availability of public transport is particularly important for the wellbeing of sensitive social groups.

13.8.55 A well-designed scheme could improve accessibility to health services and other community facilities, public transport and accessibility by public transport. This can reduce car use and tackle social exclusion, particularly for sensitive groups.

13.8.56 The Scheme can support social inclusion, lead to improvement in physical fitness, participation, physical health and mental wellbeing.

Access to work and training

13.8.57 The Scheme is likely to improve access to existing employment opportunities for various social groups and help to create new employment opportunities. People in employment are healthier, particularly those who have more control over their working conditions. Employment is also associated with income, a feeling of security, increased friendship networks and social status, which in turn are linked to better health. These positive impacts are particularly important at a time of economic downturn for tackling its negative effects on mental health, e.g. worries caused by the fear of financial strain and job loss.

Noise pollution and vibration

13.8.58 Motorised forms of transport in the core study area are a common source of noise pollution.

13.8.59 The Scheme could increase noise pollution and vibration through increased motor vehicle usage at certain locations. It can also reduce noise and vibration by encouraging a shift from cars to active travel and public transport or through smoother traffic flows.

13.8.60 Noise pollution at the levels generated by traffic can lead to annoyance, interference with speech and sleep disturbance. Stress has been suggested as a possible mechanism through which noise may affect mental and physical health. Evidence suggests noise pollution may also limit children's learning. Vibrations could give rise to stress reactions and other stressful feelings. Exposure to vehicle movement and associated noise and vibration affects mental health.

13.8.61 The likely beneficial impacts during operation stage can result in an improvement in mental health, wellbeing and stress where there is a reduction in noise and vibration. However, negative impacts will occur where there is an increase in noise and vibration.

Vehicle travellers

13.8.62 It is expected that there will be reduced congestion and delays and improved journey time reliability for communities that commute to or access work, education, social networks and services nearby.

13.8.63 The Scheme is unlikely to significantly alter the views experienced by users of the M2, however new link roads and new views will be introduced.

13.8.64 It is expected that driver stress during operation will be lower than the baseline level, with more reliable journeys for drivers using the route.

13.8.65 The bus services within the study area will see beneficial or adverse changes to their journey times.

13.9 Design, mitigation and enhancement measures

13.9.1 The population and human health assessment, being mostly based upon residual effects identified by other technical assessments, incorporates the appropriate mitigation measures identified in those chapters into the overall mitigation strategy. For example, to minimise the effects on physical health from air pollution and noise pollution, proposed mitigation measures include general communication, temporary noise barriers, general dust management, site monitoring, construction management and best practice construction practices. The Outline Environmental Management Plan (OEMP) (Appendix A in Volume 2) will be developed into a Construction Environmental Management Plan (CEMP) and implemented by the contractor and approved by the Local Authority prior to the commencement of works.

13.9.2 Construction and operational design, mitigation and enhancement measures are referenced in the following sections of the other technical assessments within the ES:

- Chapter 5: Air Quality:
  - Construction only – section 5.9;
- Chapter 6: Noise and Vibration:
  - Construction only – section 6.9;
- Chapter 8: Road Drainage and the Water Environment:
  - Construction and operation – section 8.9;
- Chapter 9: Landscape and Visual:
  - Construction and operation – section 9.9 and Table 9.14 and Table 9.16; and
- Chapter 10: Geology and Soils:
  - Construction and operation – section 10.9.

13.9.3 Recommendations have also been given in the Equality Impact Screening and Assessment (EISA) report to limit potentially disproportionate impacts as a result of the Scheme

13.9.4 Design and layout of the Scheme has been informed from a population and human health perspective through the need to minimise permanent land take affecting identified individual receptors; allow ongoing access for NMU and vehicle travellers where possible; maintain public transport routes, stops and minimise disruption; and minimise perceived severance for communities nearby. A clear and concise traffic management plan will be designed to direct users during construction and support access to local facilities.

13.10 Assessment of effects

Private dwellings: land take

Construction only

13.10.1 Permanent land take (438 m^2) and demolition of one residential unit is required for a new section of road to be built from the residential property to the roundabout. This will result in the demolition of The Gate House, Stockbury Valley, Stockbury ME9 7QD. The magnitude of impact for this loss, which includes the residential property itself, gardens, garages and other parking space, will be major adverse, resulting in large adverse effects, which is significant. This effect is permanent and irreversible for the residents of the property; however, it is an essential part of the Scheme to facilitate the buildability of the Scheme and maintain traffic flow from Maidstone Road and Oad Street to the Stockbury roundabout, throughout the construction phase. It is understood that discussions are ongoing between Highways England and the occupiers of The Gate House to agree compensation that would minimise the effects of the loss of the property and minimise any potential effects on human health.

13.10.2 The loss of The Gate House is unlikely to result in any other effects such as loss of facilities or townscape or opening views for other properties; the locality of The Gate House is well screened, there are no other private properties nearby and road infrastructure (the A249 and Oad Street) runs adjacent.

13.10.3 Permanent land take (1,012 m^2) is also required at Bowl Reed, Oad Street, Borden ME9 8JX. The magnitude of impact for the loss of this land will be major adverse, resulting in large adverse effects, which is significant. This loss will be permanent and irreversible; however, it forms an essential part of the Scheme to mitigate safety impacts at the Maidstone Road / Oad Street Junction. This land is required to create a private means of access and grant private rights of way to Bowl Reed following the closure of the current access close to the New Maidstone Road Link / Oad Street Junction. The new access to be provided will be of equal or better quality than the existing.

Table 13.18: Significance of effects for permanent land take of private property

Receptor	Land take m^2	Receptor sensitivity	Construction only	
			Magnitude of impact	Significance of effects
The Gate House	438	High	Major adverse	Large adverse (Permanent, direct, long-term and irreversible)
Bowl Reed	1,012	High	Major adverse	Large adverse (Permanent, direct, long-term and irreversible)

13.10.4 Whilst significant adverse effects are predicted on these two private residential properties, this effect is considered small scale in the context of private dwellings as a whole in the core study area. Furthermore, it is understood that discussions

have been ongoing between Highways England and the occupiers of Bowl Reed to agree alternative equal or better provision of access and between Highways England and the occupiers of The Gate House that would minimise the effects of the loss of the property and minimise any potential effects on human health. Therefore, the magnitude of impact on private dwellings as a whole is predicted to be negligible, resulting in slight adverse effects. The two residential properties do not constitute significant adverse effects on private residential properties in the context of a core study area which comprises 3,912 households.

Private dwellings: changes in access

Construction

13.10.5 Construction of the Scheme is likely to result in temporary and permanent impact on private dwellings through alteration to access.

13.10.6 A new permanent access road has been agreed with the residents of Bowl Reed, providing safe access on to Oad Street, south of Applegate Farm. Although there will be a change in access, resulting in a negligible increase in journey distance (less than 100 m), the current access is being replaced by equal or better provision.

13.10.7 During construction, minor adverse impacts are predicted on access to Milton Bungalow on Oad Street (Baden Stud and Stables) because of construction activity and tie-in works required to connect Oad Street to the New Maidstone Road link.

13.10.8 The magnitude of impact for changes in access to Bowl Reed and Milton Bungalow, and further to the north Applegates Farm, will be minor adverse, resulting in slight adverse effects, which is not significant. These effects will be temporary.

13.10.9 Maidstone Road itself and the exit slip from the A249 will be kept open until the New Maidstone Road Link is completed. Traffic light control will be in place on Maidstone Road for approximately 3 months for tie in works; after which the remainder of Maidstone Road from the viaduct to the roundabout will be closed. During construction, the magnitude of impact for disruptions to private residential properties along the southern part of Maidstone Road is predicted to be minor adverse, resulting in slight adverse effects, which are not significant. These effects will be temporary.

13.10.10 The magnitude of impact for disruption of access to Whipstakes Farmhouse and Threeways during the construction of the M2 L2 slip road and temporary closure of Oad Street will be minor adverse, resulting in slight adverse effects, which is not significant.

13.10.11 The magnitude of impact on Vale Cottages, The Coach House, Vale House, White House, Valley View Farm, and Sandina from the proposed Junction 5 L1 works is likely to be negligible, resulting in slight adverse effects, which is not significant.

13.10.12 Construction of the Scheme also has the potential to cause increased delays and changes in journey patterns which could have a negligible impact on access to private residential properties in the core study area and nearby villages. For

Stockbury, the proposed closure of the Honeycrock Hill junction with the A249 for safety reasons will result in minor impacts, resulting in slight adverse effects, which is not significant. The construction impacts on the other private dwellings in the core study area are expected to be no change, resulting in neutral effects.

Operation

13.10.13 The magnitude of impact for changes in access to residential properties in the southern part of Maidstone Road is likely to be minor adverse; the proposed closure of Maidstone Road from the viaduct to the roundabout and re-provision onto the New Maidstone Road Link and Oad Street will alter access and introduce a longer route. However, the number of properties that will be affected is low. Therefore, on balance, slight adverse effects, which is not significant, are predicted.

13.10.14 Minor beneficial magnitude of impacts, resulting in slight beneficial effects are likely for private residential properties on Oad Street (Bowl Reed, Milton Bungalow, Applegates Farmhouse, Whipstakes Farmhouse, Threeways) and south of the roundabout/A249 Mainline (Vale Cottages, The Coach House, Vale House, White House, Valley View Farmhouse and Sandina) through improved capacity and accessibility.

13.10.15 The magnitude of impact on private residential properties in Stockbury, in the wider study area, is predicted to be negligible. Improved network capacity and connectivity balanced against the closure of Honeycrock Hill junction with the A249 to vehicles is likely to result in slight adverse effects, which is not significant. Impacts on the other residential properties in the core and wider study areas are predicted to be no change, resulting in neutral effects.

Table 13.19: Significance of effects for changes in access to private dwellings

Name	Location	Sensitivity of receptor	Construction		Operation	
			Magnitude of impact	Significance of effect	Magnitude of impact	Significance of effect
Bowl Reed	Oad Street, immediately north of proposed New Maidstone Road Link	High	Minor adverse	Slight adverse (permanent, direct and long-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)
Milton Bungalow	North of proposed New Maidstone Road Link	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)
Applegates Farmhouse	Oad Street	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)

Name	Location	Sensitivity of receptor	Construction		Operation	
			Magnitude of impact	Significance of effect	Magnitude of impact	Significance of effect
Maidstone Road	Southern part of Maidstone Road	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor adverse	Slight adverse (permanent, direct and long-term)
Whipstakes farmhouse. Threeways	Oad Street	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)
Vale Cottages, The Coach House, Vale House, White House, Valley View Farmhouse Sandina	South of the roundabout, south of A249 Mainline	High	Negligible	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)
Private dwellings in Stockbury	Stockbury	High	Minor adverse	Slight adverse (temporary, direct and indirect, and short-term)	Negligible	Slight adverse (permanent, direct and long-term)
Other private residential properties	Wider study area. Nearby Villages	High	No change	Neutral	No change	Neutral

Community land and facilities: changes in access

Construction

13.10.16 No loss of community land or facilities will be required for demolition or land take purposes to construct the Scheme or accommodate the Scheme during operation.

13.10.17 There are no sensitive and essential community facilities such as health centres, educational facilities or care homes within the core study area itself. However, construction of the Scheme is likely to result in temporary impacts on other facilities used by the public through alteration to access, congestion and delays.

13.10.18 The magnitude of impact for temporary and permanent hindrance of movement to St Mary Magdalene Church (Church Hill, Stockbury) caused by the closure of the Honeycrock Hill junction with the A249 will be minor adverse as vehicle travellers and pedestrians from the surrounding area (i.e. not Stockbury itself)

will need to use Church Hill. This will have slight adverse effects, which is not significant.

13.10.19 Sittingbourne & Milton Regis Golf Club and Outdoor Pursuits and Quad Nation are located at Wormdale Hill/ Wormdale Farm respectively and are accessed via Maidstone Road. The magnitude of impact from construction activities, diversion routes and traffic management on Maidstone Road, and speed and lane restrictions, reduced capacity, and tie-ins with the new link roads, will be minor adverse. This will result in slight adverse effects, which is not significant. These effects will be temporary. During the construction phase, existing NMU routes will be maintained where possible.

Table 13.20: Significance of effects for changes in access to community facilities

Name	Location	Sensitivity of receptor	Construction only	
			Magnitude of impact	Significance of effect
St Mary Magdalene Church	Church Hill, Stockbury	High	Minor adverse	Slight adverse (temporary and permanent, direct and indirect, short-term and long-term, irreversible)
Sittingbourne and Milton Regis Golf Club	Wormdale Hill	High	Minor adverse	Slight adverse (temporary, direct, short-term)
Outdoor Pursuits and Quad Nation	Wormdale Farm	High	Minor adverse	Slight adverse (temporary, direct, short-term)

Operation

13.10.20 No significant effects are predicted during operation of the Scheme; hence this was scoped out in the Environmental Scoping Report (October 2018).

Rural enterprises

Construction

13.10.21 The Geology and Soils chapter (Chapter 10) confirms that approximately 10.3 ha of land will be taken from four agricultural holdings. Most, if not all, land within the Scheme boundary will be permanently acquired for the engineering footprint of the Scheme and planting and ecological mitigation. No other land will be severed or otherwise rendered inaccessible. This construction effect is permanent, so would continue to be observed during the operational phase.

13.10.22 The four agricultural holdings comprise E J Mackleden & Sons Ltd, Thrognall Farm, grass field between A249 and Maidstone Road, and Whipstake Farm. These agricultural holdings comprise mostly arable use, with some grazing of livestock, which will be impacted by dust or noise from construction of the

Scheme. However, as none of these agricultural holdings have diversified into non-agricultural business activities, there will be little impact/no change to the rural enterprises, resulting in neutral effects.

Operation

13.10.23 During operation, the magnitude of impact on rural enterprises will be no change as there is unlikely to be any severance, impacts on infrastructure or nuisance from the Scheme. Neutral effects are predicted on farm businesses.

Table 13.21: **Significance of effects on rural enterprises**

Name	Location	Sensitivity of receptor	Construction and operation	
			Magnitude of impact	Significance of effect
E J Mackleden & Sons Ltd	Southwest and northeast of M2 J5	Medium	No change	Neutral
Thrognall Farm	Northwest of M2 J5	Medium	No change	Neutral
grass field between A249 and Maidstone Road	between A249 and Maidstone Road	Medium	No change	Neutral
Whipstake Farm	Southeast of M2 J5	Medium	No change	Neutral

Local businesses

Construction only

13.10.24 There are several local businesses in the core study area. No demolition or land take is required from local businesses during construction or to accommodate the Scheme during operation.

13.10.25 The Scheme is expected to generate temporary disruption effects on local businesses through increased traffic congestion or delays during construction. Business operations that require customer, passing trade, delivery and/or supply chain access will be most affected. Local businesses may also be impacted by cumulative changes (e.g. noise and vibration, air quality, traffic effects) that could affect trading conditions.

13.10.26 The sensitivity of local businesses in the core study area is Low. Businesses are likely to continue to operate without substantial injury if affected by a disruption to access or worsening of trading conditions. The magnitude of impact on local businesses is predicted to be minor adverse, as only a small number of businesses, workers and residents are likely to be affected and there will be no significant change in the core study areas baseline socio-economic condition. Therefore, slight adverse effects are predicted, which is not significant.

13.10.27 Specific businesses likely to be affected by the Scheme include Baden Stables and Stud at Oad Street, just to the north of the proposed New Maidstone Road Link. Here, minor adverse impacts from dust and noise during construction are predicted for horses being fed, groomed and exercised in the stables and

paddocks. Traffic management and tie-in with the New Maidstone Road Link is unlikely to significantly disrupt access or impact on livery services offered by Baden Stables. Slight adverse effects, which is not significant, are predicted.

13.10.28 The magnitude of impact for temporary reductions in access and connectivity to Gleneagles Garage, Danaway WSW, and Glass Constructions (all on Maidstone Road), Stockbury Boarding Kennels (off Sittingbourne Road), Burden Bros Agri Ltd (Church Lane), Roydens Ltd (Hayes Lane), Kingsford E J Riding School (Norton Green), Sittingbourne & Milton Regis Golf Club and Outdoor Pursuits and Quad Nation (off Maidstone Road), and Equiprofi Ltd equestrian centre (Eyehorn Farm) from construction activity, haulage routes, increased congestion, and diversions is likely to be minor adverse, resulting in slight adverse effects, which is not significant. These effects will be temporary.

13.10.29 A construction traffic management plan, best practice construction methods, diversions, overnight closures, narrow lanes and keeping the A249 mainline open to traffic will maintain lane capacity during the day and limit disruption to local businesses in proximity to the Scheme and in the wider study area.

13.10.30 In the wider study area, the magnitude of impact on local businesses caused by disruption to business activity and increased commuter times is predicted to be minor adverse, resulting in slight adverse effects.

13.10.31 However, the Scheme will generate construction jobs and procure goods and services form construction-related businesses. At peak, 150 workers are expected to be on-site. It is predicted that 60% of workers will be local within 40 km of the Scheme. The impact magnitude of the provision of jobs for local people directly on the Scheme and through construction-related business that the Scheme procures from will be minor beneficial, resulting in slight beneficial effects, which is not significant.

Table 13.22: Significance of effects on local businesses (construction only)

Name	Location	Sensitivity of receptor	Construction only	
			Magnitude of impact	Significance of effect
Local businesses	Core study area	Low	Negligible	Slight adverse (temporary, direct and indirect, short-term)
	Wider study area	Low	Negligible	Slight adverse (temporary, direct and indirect, short-term)
Baden Stables and Stud, Oad Street	North of the proposed New Maidstone Road Link	Low	Minor adverse	Slight adverse (temporary, direct and indirect, short-term)
Gleneagles Garage, Danaway WSW, Glass Constructions	Maidstone Road	Low	Minor adverse	Slight adverse (temporary, direct and indirect, short-term)

Name	Location	Sensitivity of receptor	Construction only	
			Magnitude of impact	Significance of effect
Sittingbourne & Milton Regis Golf Club, Outdoor Pursuits and Quad Nation	off Maidstone Road	Low	Minor adverse	Slight adverse (temporary, direct and indirect, short-term)
Stockbury Boarding Kennels	off Sittingbourne Road	Low	Minor adverse	Slight adverse (temporary, direct and indirect, short-term)
Burden Bros Agri Ltd	Church Lane	Low	Minor adverse	Slight adverse (temporary, direct and indirect, short-term)
Roydens Ltd	Hayes Lane	Low	Minor adverse	Slight adverse (temporary, direct and indirect, short-term)
Kingsford E J Riding School	Norton Green	Low	Minor adverse	Slight adverse (temporary, direct and indirect, short-term)
Equiprofi Ltd equestrian centre	Eyehorn Farm	Low	Minor adverse	Slight adverse (temporary, direct and indirect, short-term)
Local labour market	Core and wider study areas	Low	Minor beneficial	Slight beneficial (temporary, direct and indirect, short-term, possibly long-term)

Non-motorised users

13.10.32 Most PRoW in the core study area are footpaths with some sections of byway (Green Lane and Woodgate Lane) and a bridleway parallel to the A249 north of Danaway. There are several minor roads near the Scheme which may attract NMU, particularly cyclists, such as Honeycrock Hill, Pett Lane Oad Street, and Maidstone Road; however, these routes are not totally suitable for pedestrians and cyclists as there are no pavements or dedicated cycleways. Usage of footways and PRoW in the core study area is low. No facilities for pedestrians and cyclists exist at Junction 5 and very few pedestrians and cyclists have been observed.

13.10.33 Changes are proposed to NMU routes in the core study area with most existing footpaths retained, some sections removed, and new public footpaths created. Below is a summary of the proposed changes.

- Footpaths to be removed:
  - Part of PRoW footpath Kent ZR 71, north of the A249 northbound carriageway, east of the gyratory (to be replaced by a section of new public footpath, diverting along a shorter, more direct route);
  - Part of PRoW footpath Kent KH 85, running northeast from the west of the roundabout (to be replaced by a section of new public footpath, diverting westwards, connecting to Honeycrock Hill);
- Proposed new public footpaths:
  - In addition to the above new public footpath provision, a new public footpath is proposed, running westwards from the north of the roundabout, connecting to Honeycrock Hill and Church Hill junction, near to St Mary Magdalene Church.

13.10.34 The above construction effects are permanent, so would continue to be applicable during the operational phase.

13.10.35 NMU trips in the area are likely to mostly comprise recreational trips, with some commuter journeys. Recreational trips are generally considered less sensitive to changes in journey length in that users are not necessarily seeking the fastest or most direct route from their location to a specific destination. A variety of alternate recreational routes not directly affected by the Scheme are available in the core study area.

13.10.36 There are currently four bus stops in the Scheme area, following the removal of the two bus stops to the north of Church Hill for safety reasons. Two of these are located on either side of the A249, approximately 60 m south of where Oad Street meets the A249 and two others are located on either side of Maidstone Road approximately 800 m north of Junction 5. The Scheme proposes to maintain the existing bus route through the roundabout. The two bus stops near the junction (located either side of the A249) will be relocated to the Oad Street link.

Changes in journey length

Construction

13.10.37 On the information available from the contractor at this stage, the new sections of public footpath, to replace/divert the existing footpaths to be removed (PRoW ZR71 and KH85), will be in place before the existing footpaths are removed. This means there will be no substantial change in journey length for users of these routes during construction. The magnitude of impact on these PRoW is predicted to be no change, resulting in neutral effects. It is unlikely there will be any significant impacts on the other PRoW in the area.

13.10.38 For NMU on nearby routes, such as Honeycrock Hill, Pett Road, Maidstone Road and Oad Street there is predicted to be minor adverse magnitude of impacts due to temporary increases in journey distance and journey time from the closure and/or diversion of the routes and increased difficulty in road crossing, which may result in changes to travel patterns and affect the degree to which parts of Maidstone Road and Oad Street in particular are subject to ‘community severance’. The significance of effects is predicted to be slight

adverse, which is not significant. The magnitude of impact on the other footways in the wider area is likely to be negligible, resulting in slight adverse effects.

13.10.39 On the information available, including the Regional Investment Programme M2 Junction 5 Improvements WCHAR Review produced by Atkins in February 2019, the affected PRoW and footways are unlikely to be highly utilised, particularly by sensitive groups. However, due consideration will still need to be given in any temporary re-routing and provision of suitable signage and crossing points.

13.10.40 The magnitude of impact for pedestrians accessing bus stops in the area is predicted to be minor adverse due to temporary increases in journey distance and journey times from closure and/or diversion of NMU routes and increased difficulty in road crossing which may result in changes to travel patterns, resulting in slight adverse effects, which is not significant.

Operation

13.10.41 During operation, the design of the Scheme will not significantly alter journey distance, journey time or patterns for pedestrians and others, to the degree to which a locality becomes subject to “community severance”.

13.10.42 Although the existing footpath that forms part of PRoW footpath Kent ZR 71 will be removed to facilitate the proposed works east of the gyratory, ZR 71 will be diverted by the creation of a new public footpath. This proposed new footpath will be more direct and is aligned parallel to the A249 mainline, away from the carriageway. This will result in a slight decrease in journey length. The magnitude of impact for this change will be minor beneficial, resulting in slight beneficial effects, which is not significant.

13.10.43 Part of PRoW footpath Kent KH 85 will be removed to the west of Junction 5 and extended west to link to the bottom of Honeycrock Hill/A249 Junction which is being stopped up, extending along Honeycrock Hill to Church Hill junction. Although the existing route runs towards the location of one of the former bus stops, this has now been removed and any access towards Oad Street to the south is across the busy A249 carriageway. Therefore, the section of footpath to be removed is more than compensated by improvement to the existing NMU network through provision of new amenities and providing improved connectivity between Junction 5 and Stockbury. Overall, this is predicted to result in minor beneficial impacts on overall journey time and distance through increased options, resulting in slight beneficial effects, which is not significant.

13.10.44 The magnitude of the closure of Honeycrock Hill Junction with the A249 for safety reasons and introduction of the new PRoW facility (extension of KH 85) along this route will be minor beneficial, as it will improve the existing NMU network and provide new amenities where none currently exist, resulting in slight beneficial effects. The existing NMU environment at Honeycrock Hill is unsuitable and unsafe for pedestrians and cyclists.

13.10.45 The magnitude of impact for the relocated bus stops to the Oad Street Link will be minor beneficial through reduced journey distance and journey time for people using public transport in the local area, resulting in slight beneficial effects, which is not significant. The Scheme will also provide a safer environment for pedestrians and other users on local roads through reduced congestion, free flow of traffic and removal of unsafe junctions at Honeycrock

HIll/A249 and the A249/Maidstone Road slip. Slight beneficial effects on journey distance and journey patterns, which is not significant, are therefore predicted.

Amenity

Construction

13.10.46 The pleasantness of journeys in the core and wider study area will be generally reduced by increased traffic and the introduction of construction traffic and noise, traffic management and temporary alteration to routes. Significant effects are predicted in the Landscape and Visual chapter (Chapter 9) for change in views from several sensitive NMU receptors, including PRoW KH80, KH81, KH85, ZR70 and ZR71, various recreational receptors, and residential and employment areas. However, with appropriate mitigation in place, any effects from noise and/or air pollution are predicted to be not significant.

13.10.47 Overall, the magnitude of impact on the pleasantness of journeys for NMU in general in the core study area, and pedestrians and cyclists using Honeycrock Hill, PRoW, footways, recreational areas and bus stops is predicted to be minor adverse because of worsening conditions and increase in journey length, resulting in slight adverse effects, which is not significant.

Operation

13.10.48 Overall, the Scheme will provide direct and indirect enhancements to the pedestrian and cycle environment and human health through reduced congestion, free flow of traffic, reduced accidents and improved safety. This will improve the pleasantness of the journey and the ability for pedestrians and other users to travel safely in the locality of the Scheme and connect to local areas.

13.10.49 Significant effects are predicted in the Landscape and Visual chapter (Chapter 9) for changes in view from several sensitive NMU receptors in the opening year, including PRoW KH80, KH81, KH85 and ZR71; however after the establishment of mitigation planting, the visual effects on these PRoW will reduce to slight adverse by Operation Year 15, which is not significant.

13.10.50 The magnitude of impact for the diversion of PRoW KH85 and ZR71 and the creation of new public footpaths will be minor beneficial due to overall improvements to this part of the PRoW network, resulting in slight beneficial effects, which is not significant. Slight beneficial effects are also predicted for users of the existing bus stops on Maidstone Road and the two bus stops proposed for Oad Street, and the other PRoW and footways in the core study area.

13.10.51 The magnitude of impact following the closure of Honeycrock Hill junction, through removal of through traffic and creation of a new pedestrian and cycling link between Stockbury and the A249/local area, will be moderate beneficial for a low number of users, resulting in moderate beneficial effects, which is significant.

Severance

Construction

13.10.52 Whilst construction activity, congestion, changes in traffic flows and journey times are likely to be temporary and short-term, local communities are expected to experience a temporary overall increase in severance, resulting in slight severance for communities accessing facilities and services nearby.

13.10.53 Operation

13.10.54 Once operational, improvements in journey times and journey patterns from improved network performance, free flow of traffic and reduced congestion on the M2, A249 and local roads, will improve amenity for residents accessing services and facilities in the local area, resulting in no change or a slight decrease in severance for local communities.

13.10.55 A combined reporting schedule listing the predicted impacts for NMU changes in journey length and journey time, amenity, and severance is included in Table 13.23.

Table 13.23: Significance of effects on non-motorised users

NMU route	Location	Criteria type for NMU assessment	Sensitivity of receptor	Construction		Operation	
				Magnitude of impact	Significance of effect	Magnitude of impact	Significance of effect
PRoW footpath Kent ZR 71	Immediately north of the A249 northbound carriageway, east of the gyratory	**Journey length and journey time**	High	No change	Neutral	Minor beneficial	Slight beneficial (permanent, direct and long-term)
		Amenity	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)
		Severance	High	Slight severance		Slight reduction in severance	
PRoW footpath Kent KH 85	Running northeast from the west of the roundabout	**Journey length and journey time**	High	No change	Neutral	Minor beneficial	Slight beneficial (permanent, direct and long-term)
		Amenity	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)
		Severance	High	Slight severance		Slight reduction in severance	
Other PRoW	Throughout the wider study area	**Journey length and journey time**	High	No change	Neutral	No change	Neutral
		Amenity	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)
		Severance	High	Slight severance		No change	
Honeycrock Hill	West of M2 J5	**Journey length and journey time**	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)

NMU route	Location	Criteria type for NMU assessment	Sensitivity of receptor	Construction		Operation	
				Magnitude of impact	Significance of effect	Magnitude of impact	Significance of effect
		Amenity	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Moderate beneficial	Moderate beneficial (permanent, direct and long-term)
		Severance	High	Slight severance		Slight reduction in severance	
Footways on Pett Road, Oad Street, Maidstone Road	South and east of M2 J5	**Journey length and journey time**	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)
		Amenity	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)
		Severance	High	Slight severance		No change	
Bus stops	Wider study area	**Journey length and journey time**	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)
		Amenity	High	Minor adverse	Slight adverse (temporary, direct and short-term)	Minor beneficial	Slight beneficial (permanent, direct and long-term)
		Severance	High	Slight severance		No change/Slight reduction in severance	

Human health

13.10.56 The construction and operational phases of the Scheme are anticipated to generate changes to health determinants. Effects on human health have been assessed by bringing together the assessment of receptors' sensitivity with the magnitude of impacts to health determinants, outlined in Table 13.24 below.

Air pollution

Construction

13.10.57 Using the findings from the Air Quality chapter (Chapter 5), during construction the magnitude of impact on all groups from air pollution is predicted to be minor. If left unmitigated and due to the sensitivity of certain sub-groups of the population, this would result in moderate or large adverse effects on sensitive groups containing families with children and adolescents, and people who are physically or mentally disadvantaged and slight adverse effects for the local population overall, people of certain ethnicity and/or gender, and people who are materially disadvantaged.

13.10.58 However, the effect on local air quality arising from dust and particulate matter emissions during construction will only be temporary and will be minimised through the adoption of appropriate mitigation measures. This includes regular water-spraying and sweeping of unpaved and paved roads; using wheel washes, shaker bars or rotating bristles for vehicles leaving the site where appropriate; sheeting vehicles carrying dusty materials to prevent materials being blown from the vehicles whilst travelling; enforcing speed limits for vehicles on unmade surfaces; ensuring any temporary site roads are no wider than necessary; damping down of surfaces prior to their being worked; and storing dusty materials away from site boundaries and in appropriate containment (e.g. sheeting, sacks, barrels etc.). With these mitigation measures in place, the magnitude of impact from air pollution during construction will be negligible, resulting in slight adverse effects on the local population overall and on all sensitive groups, which is not significant.

Operation

13.10.59 Small increases in annual mean NO_2 concentrations are estimated in the Air Quality chapter (Chapter 5) at four human health receptors (out of 55 selected). This includes Workhouse Cottage, 1 Pilgrims Way and Kent County Show Ground in Detling, and Whipstakes Farm, Stockbury. Imperceptible changes or decreases in concentrations are estimated at all other human health receptors. In all cases, annual mean NO_2 concentrations were below the national air quality objective at all locations. Therefore, the magnitude of impact from air pollution from the operation of the Scheme is predicted to be negligible, resulting in slight adverse effects for the local population overall and all sensitive groups, which is not significant. As no significant effects are predicted, no mitigation measures are proposed.

Risk of injuries and deaths

Construction

13.10.60 During construction, increases in construction traffic in the core study area and alteration to traffic routes and patterns may increase the risk of injury and death because of increased construction traffic and an unawareness of altered traffic movements, particularly for sensitive road users (e.g. motorcyclists, elderly drivers, children and adolescents, pedestrians, new drivers and cyclists), albeit slower vehicle movements may temporarily improve the current situation. If left unmitigated, these factors could have moderate or large adverse impacts on families with children and adolescents, and people who are physically or mentally disadvantaged, which could result in significant effects.

13.10.61 However, it is anticipated that most construction traffic movement will be within the M2/M20/A249 mainlines, with some construction traffic movements on Oad Street and from the proposed compound site on Maidstone Road, without the need to use other local roads.

13.10.62 To minimise impacts, traffic light control will be in operation 24/7 on Maidstone Road and Oad Street for tie in works during Phase 1A, full overnight closures are proposed for one lane of the A249 northbound and narrow lanes will operate southbound during Phase 2 of the works, the roundabout will be reduced to 2 lanes on the gyratory during Phase 3, and one lane restrictions and weekend closures of the southbound on-slip are proposed for Phase 4.

13.10.63 Speed limits for roads will be 50 mph and there will be a reduction to 30 mph at the roundabout. The closure of Honeycrock Hill junction with the A249 for safety reasons and proposed closure of the remainder of Maidstone Road from the viaduct to the roundabout, once the new link roads have been completed, will also improve the current situation. During construction, existing NMU routes will be maintained where possible.

13.10.64 On balance, it is predicted that with these mitigation measures in place, the magnitude of impact of the Scheme on risk of injuries and death will be minor adverse through short-term, temporary impacts affecting a low number of people. This will result in slight adverse effects on the local population overall and on all sensitive groups, which is not significant.

Operation

13.10.65 During operation, there may be a reduction in traffic-related injuries and risk through reduced congestion and queues which would lower the probability of rear-end shunt accidents as slowing vehicles interact with stationary traffic streams. Lane widening and reduction of congestion at the junction will increase capacity on the M2 and reduce the need for trips to be diverted onto less suitable roads in the event of an accident. This will improve conditions on the M2 and A249 mainlines, Junction 5 and the approaches to the junctions.

13.10.66 The Scheme is likely to reduce congestion on other local roads in the area, which can become congested especially in the event of incidents on the M2 and diversions; this would have positive benefits for the core study area.

13.10.67 Smoother traffic flow and changes in traffic numbers on parts of the M2 mainline and during am and pm peak periods could however, have adverse impacts, particularly for sensitive users prone to any changes.

13.10.68 Using the assessment criteria set out in Table 13.14, the magnitude of impact on risk of injuries and death as a result of the operational phase of the Scheme is predicted to be minor beneficial, resulting in moderate beneficial effects, which is significant, for families with children and adolescents and people who are physically or mentally disadvantaged, through improvements to NMU routes, traffic displacement where there were previously safety concerns, improved safety for drivers, and improved access to local services.

13.10.69 Minor beneficial impacts, through general improvements to the environment for vehicle travellers, pedestrians and others, will result in slight beneficial effects for the local population overall and the sensitive groups that include people from certain ethnicity and/or gender and people who are materially disadvantaged.

13.10.70 Overall, these beneficial effects would contribute to the wider aspirations of the local boroughs to reduce the number of injuries and deaths, particularly in Swale borough around Junction 5.

Soil and water pollution

Construction

13.10.71 The magnitude of impact of contaminants in soil and groundwater on wider groups without mitigation could be significant. However, with the appropriate mitigation measures outlined in section 10.9 in the Geology and Soils chapter (Chapter 10) in place, such as Health and Safety Risk Assessment and Methods Statements (RAMS), dust suppression measures, working method statements to manage groundwater and run-off, stockpile management, implementation of appropriate earthworks, soil exposure and pollution control measures, safe storage of fuels, oils and equipment, and the completion of a detailed UXO desk study, the magnitude of impact is predicted to be minor adverse, resulting in slight adverse effects, which is not significant.

13.10.72 The magnitude of impact on local population groups and sensitive groups from construction dust and ground gases is predicted to be negligible to minor beneficial, resulting in slight beneficial effects for the local population overall and all sensitive groups, which is not significant.

13.10.73 The magnitude of impact on the local population overall and all sensitive groups from inhalation of vapours from soil and/or groundwater is predicted to be minor adverse, resulting in slight adverse effects, which is not significant.

Operation

13.10.74 There will be no impacts to the health of construction workers or site workers as these receptors are not present during operation.

13.10.75 The magnitude of impact on the local population overall and sensitive groups from inhalation, ingestion and physical contact with dust, and inhalation and ingestion of generated ground gases is predicted to be negligible and minor

beneficial respectively, resulting in slight beneficial effects for the local population and all sensitive groups, which is not significant.

13.10.76 The magnitude of impact for all groups from inhalation of vapours from soil and/or groundwater during the operational phase will be negligible, resulting in slight adverse effects for the local population overall and all sensitive groups, which is not significant.

Access to housing, education, health care services and other social infrastructure

Construction

13.10.77 Access to services is vital in the core and wider study area, enabling access to health care and other services, and enhancing opportunities for physical activity, wellbeing, participation, community interaction and social cohesion.

13.10.78 Construction of the Scheme is likely to result in temporary adverse impacts on access to housing in the core study area and to education, health care services and other social infrastructure in the wider study area. Accessibility is a critical component of locally-based travel; car ownership amongst sensitive groups in the core study area is low. Therefore, the availability of other transport options in the Scheme area is important for the wellbeing of sensitive groups.

13.10.79 Motorised vehicle travellers and public transport users are likely to face disruptions to travel activity and increased commuter times due to construction activity, increase in construction vehicles, diversions, and traffic management. People who are materially disadvantaged and other sensitive groups could be disproportionately affected, which could lead to social exclusion and contribute negatively to quality of life and health. Specific groups such as teenagers, the elderly, job seekers and people living in remote locations would be most affected. No bus stops will need to be temporarily or permanently re-located during construction of the Scheme.

13.10.80 The magnitude of impact during construction on access to housing, education, health care services and other social infrastructure is likely to be minor adverse for the local population overall and all sensitive groups, resulting in slight adverse effects, which is not significant. These slight temporary effects are likely to affect a low-moderate number of the local population and only a small proportion of the sensitive groups.

Operation

13.10.81 The Scheme is anticipated to improve accessibility to housing, education, health care services and other community facilities by increasing capacity and improving accessibility to facilities in the wider study area, helping to address some of the current deficiencies in the area, such as the living environment and barriers to services.

13.10.82 Access to public transport and improved accessibility by public transport, through reduced congestion and improved journey time reliability, may reduce car use and tackle social exclusion, particularly for sensitive groups.

13.10.83 In doing so, the magnitude of impact of the Scheme on access to housing, education, health care services and other social infrastructure during the operational phase is predicted to be minor beneficial, resulting in slight beneficial effects for the local population overall and sensitive groups, which is not significant.

Access to work and training

Construction

13.10.84 Construction of the Scheme will generate new employment opportunities, with the Principle Contractor, anticipating that during construction 60% of workers (around 90) will be employed on-site from within 40 km of the Scheme. This could provide financial security and contribute to self-esteem, particularly for people who are materially disadvantaged in the core and wider study areas. Whilst the construction period would be temporary, access to skills and training for new workers would have long-term benefits. The supply chain could also benefit from improved visibility and smoothing of the pipeline for work.

13.10.85 It is predicted there could be temporary adverse impacts for people accessing work and training in the area resulting from lane closures or diversions and disruption to traffic flows. This could have particular impacts and disruption for sensitive groups such as people who are materially disadvantaged without access to a car and/or reliant on the public transport network.

13.10.86 Using the assessment criteria set out in Table 13.14, the impact magnitude for people accessing work and training in the core and wider study areas and through the generation of new employment opportunities is predicted to be minor beneficial, resulting in slight beneficial effects for the local population overall, people from certain ethnicity or gender, people who are physically or mentally disadvantaged, and people who are materially disadvantaged. People who are materially disadvantaged, or a proportion of this sensitive sub-group, could benefit most from new employment opportunities. For families with children and adolescents, the impact magnitude is likely to be no change, resulting in neutral effects.

Operation

13.10.87 During operation, improved network performance and capacity could enable improved access to existing employment and facilitate key employment and housing sites coming forward for development. Better and improved access would help to create new employment opportunities.

13.10.88 The Scheme is likely to improve access to employment opportunities for various social groups which will be a positive factor for health, providing financial security and contributing to self-esteem.

13.10.89 Using the assessment criteria set out in Table 13.14, the magnitude of impact of the Scheme on access to work and training once operational, will be minor beneficial. This will result in minor beneficial effects for the local population overall and for some sensitive groups: people from certain ethnicity or gender, people who are physically or mentally disadvantaged, and people who are materially disadvantaged, which is not significant. This could result in positive effects on health and wellbeing through an improvement in the socio-economic

status of these groups. For families with children and adolescents, the impact magnitude is likely to be no change, resulting in neutral effects.

Noise pollution and vibration

Construction

13.10.90 The Noise and Vibration chapter (Chapter 6) finds that without noise mitigation, areas represented by Threeways, Vale Cottages, The Studios, Whipstakes Farm and Sandina could be significantly affected by construction works. However, temporary noise barriers adjacent to the works are predicted to improve noise levels and therefore levels are not predicted to be significant. Therefore, the magnitude of impact from daytime construction noise is predicted to be negligible, resulting in slight adverse effects for the local population overall and all sensitive groups, which is not significant.

13.10.91 The magnitude of impact for the other residential properties in the wider study area is predicted to be negligible, resulting in slight adverse effects for the local population overall and sensitive groups, which is not significant.

13.10.92 To mitigate any potential noise and vibration impacts during construction, the construction contractor should consult with the Environmental Health Departments at the relevant Local Planning Authorities to obtain guidance on the requirements for managing and controlling noise and vibration. The Outline Environmental Management Plan (OEMP) will be developed into a Construction Environmental Management Plan (CEMP) and implemented by the contractor and be approved by the Local Authorities prior to the commencement of construction works. A Traffic Management Plan shall also be provided in the CEMP to manage the routing of construction traffic and road diversions.

13.10.93 The contractor shall keep residents informed of the progress of works, including when the noisiest activities will be taking place and how long they are likely to last. In addition, the contractor shall use several good working practices that will minimise impacts to sensitive receptors. These measures include fitting vehicles and plant with silencers, mufflers or suppressors, plant certified to meet current EU legislation, and appropriate cleaning and handling of machinery and materials.

13.10.94 In addition to the above working practices, where piling is required, the piling method should be carefully selected to minimise noise and vibration impacts at receptors.

13.10.95 Best practice, considerate working hours, as well as frequent and open communications with residents will help to reduce impacts. Where night-time works are required, impacts can be reduced if works are limited to essential works only. Where a significant impact is predicted at a noise sensitive property from construction activity, the contractor will undertake formal consultation with the local planning authority to obtain approval of the works through a section 61 agreement. With mitigation measures in place, the magnitude of impact from night-time activities is likely to be minor adverse, resulting in slight adverse effects on the local population and all sensitive groups, which is not significant.

13.10.96 Based on the predicted vibration levels outlined in the Noise and Vibration chapter (Chapter 6) there is unlikely to be any significant adverse effects from

construction vibration due to the distance of vibration inducing works. In addition, standard vibration inducing construction works are not anticipated within 20 m of any vibration sensitive receptors, the distance beyond which construction vibration impact from construction plant or access routes is unlikely to be significant.

13.10.97 With careful planning of site access routes and limiting the use of construction plant within 20 m of any vibration sensitive receptor, no significant construction vibration impact from construction plant or access routes is likely.

13.10.98 The magnitude of impact from vibration is predicted to be negligible, resulting in slight adverse effects on the local population overall and all sensitive groups.

Operation

13.10.99 During the operational phase, no significant adverse effects are identified. One property on Maidstone Road is predicted to be subject to a minor increase in noise in the short-term only, resulting in slight adverse effects, which is not considered to be significant.

13.10.100 Negligible increases in noise are predicted at 82 residential receptors and 1 non-residential receptor in the study area, resulting in slight adverse effects, which is not significant.

13.10.101 Beneficial decreases in noise are predicted at 14 residential receptors and minor decreases predicted at 12 residential receptors and 1 non-residential receptor, resulting in slight beneficial effects, which is not significant.

13.10.102 Moderate decreases in noise are predicted for 7 residential receptors and major decreases predicted for 2 residential receptors in Stockbury Valley due to the change in the road alignment both vertically and horizontally that moves the source of noise away from these locations and low noise road surfacing on all lanes of the A249, resulting in moderate beneficial and large beneficial effects respectively, which is significant.

13.10.103 The magnitude of impact at Noise Important Areas (NIAs 4574 and 4575) is predicted to be moderate beneficial in the opening year and minor beneficial in the future year following predicted decreases of 4 dB or more at properties within the two NIAs. Reduction in noise in these locations is related to:

- Change in the road alignment, moving the road away from the area, and
- Provision of lower noise road surfacing on the A249.

13.10.104 This will result in moderate beneficial effects on the local population overall and all sensitive groups for both years, which is significant.

13.10.105 The impacts on the other NIA's and other private residential properties in the wider study area is predicted to be negligible, resulting in neutral to slight adverse effects on local population overall and all sensitive groups, which is not significant.

13.10.106 No significant adverse effects are predicted from airborne vibration nuisance levels or ground-borne vibration as all new roads will have a smooth surface and be located at least 5 m from residential properties. As no significant effects were shown, there are no residual vibration impacts. Negligible impacts are predicted,

resulting in slight adverse effects on local population overall and all sensitive groups, which is not significant.

Vehicle travellers

View from the road

Construction

13.10.107 During construction, views would be altered by the presence of construction activity and associated machinery, excavation and remodelling works, temporary lighting for night-time working, hoarding and fencing, signage and traffic management features, building of structures, and disruption to landscape features, including loss of vegetation and opening-up of views towards the Scheme. Changes in view would be most prominent immediately adjacent to the proposed works. The Landscape and Visual chapter (Chapter 9) confirms that a number of construction mitigation measures have been developed as part of the iterative design to minimise potential impacts. These measures include locating the construction compound within the existing Volkerlaser construction site beneath the M2 viaduct in a relatively hidden position, protecting soil structures, implementing the Outline Environmental Management Plan (OEMP), ensuring that valued trees, woodland, existing vegetation and other landscape features are protected and retained where possible, and the implementation of Considerate Construction management.

13.10.108 The Landscape and Visual chapter (Chapter 9) predicts slight adverse effects on views from Wormdale Hill, the A249 travelling west towards M2 J5, Maidstone Road running southwest to Junction 5, Oad Street overpass and along the A249 (viewpoint 16). Moderate adverse effects are predicted for views from Oad Street and along the A249 (viewpoint 13). These effects would be temporary and shot-term. On balance, views from the road are likely to be worse during construction.

13.10.109 Due to the short-term and temporary nature of the construction effects identified, it is not considered feasible to include any additional landscape mitigation measures to further reduce the construction phase effects.

Operation

13.10.110 The Scheme proposals are similar to the existing highways infrastructure and the 7.4 m (maximum height) Stockbury flyover, although a further urbanising vertical feature is in close proximity to the existing M2 viaduct. The increase in roadway and creation of the new Maidstone Road/Oad Street links will exacerbate the impacts of views. The loss of mature highways vegetation will feature as a significant short to medium term impact, producing moderate adverse effects for views along Oad Street and the A249 at Opening Year 1. However, once mitigation planting has become established, this will reduce to no significant residual effect and provide sufficient screening for most receptors immediately adjacent to the Scheme.

13.10.111 Operation mitigation measures include off-site mitigation in the form of bolstered tree and shrub planting along Church Hill following consultation and advice from the Kent Downs AONB; timber posts and rails; traffic islands around Stockbury roundabout to be paved with locally sourced Kentish Ragstone, earthworks removed along the southern side of the A249 adjacent to residential

properties to retain the important mature tree and shrub belts here and provide a visual separation from the road; extensive woodland planting adjacent to Church Wood; important hedgerows along Oad Street and adjacent to Honeycrock Hill to be translocated along Oad Street and any remaining gaps to be infilled with hedgerow; tree planting and wildflower understorey; and chalk grassland proposed on appropriately situated cutting slopes.

13.10.112 A soft landscape scheme, including native species, has been designed either side of the entire length of the route (aside from areas where as much vegetation as possible has been retained) to minimise the impacts of the Scheme on the adjoining land.

13.10.113 On balance, views from the road for vehicle travellers is likely to be worse during operation, however with the establishment of mitigation planting this will not be significant.

Driver stress

Construction

13.10.114 Driver stress is predicted to increase temporarily during construction because of construction activity, diversions, disruption to traffic and road flows, temporary speed limits, increased construction traffic, and potential for pedestrians stepping into the road. However, slower speeds will potentially create a safer environment, reducing the risk of injury or death from road traffic accidents.

13.10.115 Overall, on balance, using the three-point descriptive scale for the assessment of driver stress recommended under DMRB guidance, the effect of the Scheme on driver stress during construction is predicted to be low.

Operation

13.10.116 In general, driver stress on the M2 mainline, A249 and slip roads is likely to decrease during operation due to increased capacity, improved journey times and reduced delays, meaning people will have quicker and more reliable journeys and improved safety for all road users. Increases in traffic however, could have adverse effects. Overall, on balance, the effect of the Scheme on driver stress during the operational phase is predicted to be low.

Table 13.24: Significance of effects of wider health determinants (summary)

Activity	Baseline		Construction		Operation	
Wider health determinant	**Receptor**	**Receptor sensitivity**	**Impact magnitude**	**Significance of effects**	**Impact magnitude**	**Significance of effects**
Air pollution	Local population overall	High	Negligible	Slight adverse (Not significant) (temporary, direct and short-term)	Negligible	Slight adverse (Not significant) (permanent, direct and long-term)
	Sensitive receptor – Families with children and adolescents	Very High	Negligible	Slight adverse (Not significant) (temporary, direct and short-term)	Negligible	Slight adverse (Not significant) (permanent, direct and long-term)
	Sensitive receptor – People from certain ethnicity and/or gender	High	Negligible	Slight adverse (Not significant) (temporary, direct and short-term)	Negligible	Slight adverse (Not significant) (permanent, direct and long-term)
	Sensitive receptor – People who are physically or mentally disadvantaged	Very High	Negligible	Slight adverse (Not significant) (temporary, direct and short-term)	Negligible	Slight adverse (Not significant) (permanent, direct and long-term)
	Sensitive receptor – People who are materially disadvantaged	High	Negligible	Slight adverse (Not significant) (temporary, direct and short-term)	Negligible	Slight adverse (Not significant) (permanent, direct and long-term)
Risk of injuries and death	Local population overall	Medium	Minor adverse	Slight adverse (Not significant) (temporary, direct and indirect, short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct and indirect, long-term)
	Sensitive receptor – Families with children and adolescents	Very High	Minor adverse	Slight adverse (Not significant) (temporary, direct and indirect, short-term)	Minor beneficial	Moderate beneficial (Significant) (permanent, direct and indirect, long-term)

Activity	Baseline		Construction		Operation	
Wider health determinant	**Receptor**	**Receptor sensitivity**	**Impact magnitude**	**Significance of effects**	**Impact magnitude**	**Significance of effects**
	Sensitive receptor – People from certain ethnicity and/or gender	High	Minor adverse	Slight adverse (Not significant) (temporary, direct and indirect, short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct and indirect, long-term)
	Sensitive receptor – People who are physically or mentally disadvantaged	Very High	Minor adverse	Slight adverse (Not significant) (temporary, direct and indirect, short-term)	Minor beneficial	Moderate beneficial (Significant) (permanent, direct and indirect, long-term)
	Sensitive receptor – People who are materially disadvantaged	Medium	Minor adverse	Slight adverse (Not significant) (temporary, direct and indirect, short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct and indirect, long-term)
Soil and Water pollution (Construction dust and ground gases)	Local population overall	Medium	Negligible to Minor beneficial	Slight beneficial (Not significant) (temporary, direct and short-term)	Negligible	Slight beneficial (Not significant) (permanent, direct and long-term)
	Sensitive receptor – Families with children and adolescents	High	Negligible to Minor beneficial	Slight beneficial (Not significant) (temporary, direct and short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct and long-term)
	Sensitive receptor – People from certain ethnicity and/or gender	Medium	Negligible to Minor beneficial	Slight beneficial (Not significant) (temporary, direct and short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct and long-term)
	Sensitive receptor – People who are physically or mentally disadvantaged	High	Negligible to Minor beneficial	Slight beneficial (Not significant) (temporary, direct and short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct and long-term)

Activity	Baseline		Construction		Operation	
Wider health determinant	**Receptor**	**Receptor sensitivity**	**Impact magnitude**	**Significance of effects**	**Impact magnitude**	**Significance of effects**
	Sensitive receptor – People who are materially disadvantaged	Medium	Negligible to Minor beneficial	Slight beneficial (Not significant) (temporary, direct and short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct and long-term)
Soil and Water pollution (Inhalation of vapours from soil and/or groundwater)	Local population overall	Medium	Minor adverse	Slight adverse (Not significant) (temporary, direct and indirect, short-term)	Negligible	Slight adverse (Not significant) (permanent, direct and indirect, long-term)
	Sensitive receptor – Families with children and adolescents	High	Minor adverse	Slight adverse (Not significant) (temporary, direct and indirect, short-term)	Negligible	Slight adverse (Not significant) (permanent, direct and indirect, long-term)
	Sensitive receptor – People from certain ethnicity and/or gender	Medium	Minor adverse	Slight adverse (Not significant) (temporary, direct and indirect, short-term)	Negligible	Slight adverse (Not significant) (permanent, direct and indirect, long-term)
	Sensitive receptor – People who are physically or mentally disadvantaged	High	Minor adverse	Slight adverse (Not significant) (temporary, direct and indirect, short-term)	Negligible	Slight adverse (Not significant) (permanent, direct and indirect, long-term)
	Sensitive receptor – People who are materially disadvantaged	Medium	Minor adverse	Slight adverse (Not significant) (temporary, direct and indirect, short-term)	Negligible	Slight adverse (Not significant) (permanent, direct and indirect, long-term)
Access to housing, education, health care services and other social infrastructure	Local population overall	Medium	Minor adverse	Slight adverse (Not significant) (temporary, direct, and short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct, long-term)
	Sensitive receptor – Families with	High	Minor adverse	Slight adverse (Not significant) (temporary, direct, and short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct, long-term)

Activity	Baseline		Construction		Operation	
Wider health determinant	**Receptor**	**Receptor sensitivity**	**Impact magnitude**	**Significance of effects**	**Impact magnitude**	**Significance of effects**
	children and adolescents					
	Sensitive receptor – People from certain ethnicity and/or gender	High	Minor adverse	Slight adverse (Not significant) (temporary, direct, and short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct, long-term)
	Sensitive receptor – People who are physically or mentally disadvantaged	High	Minor adverse	Slight adverse (Not significant) (temporary, direct, and short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct, long-term)
	Sensitive receptor – People who are materially disadvantaged	High	Minor adverse	Slight adverse (Not significant) (temporary, direct, and short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct, long-term)
Access to work and training	Local population overall	High	Minor beneficial	Slight beneficial (Not significant) (temporary, direct and indirect, short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct, long-term)
	Sensitive receptor – Families with children and adolescents	Low	No Change	Neutral	No Change	Neutral
	Sensitive receptor – People from certain ethnicity and/or gender	High	Minor beneficial	Slight beneficial (Not significant) (temporary, direct and indirect, short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct, long-term)
	Sensitive receptor – People who are physically or mentally disadvantaged	High	Minor beneficial	Slight beneficial (Not significant) (temporary, direct and indirect, short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct, long-term)

Activity	Baseline		Construction		Operation	
Wider health determinant	**Receptor**	**Receptor sensitivity**	**Impact magnitude**	**Significance of effects**	**Impact magnitude**	**Significance of effects**
	Sensitive receptor – People who are materially disadvantaged	High	Minor beneficial	Slight beneficial (Not significant) (temporary, direct and indirect, short-term)	Minor beneficial	Slight beneficial (Not significant) (permanent, direct, long-term)
Noise pollution	Local population overall and all sensitive receptors	High	Minor Adverse or negligible	Slight adverse (Not significant) (temporary, direct and short-term)	N/A	N/A
Vibration	Local population overall and all sensitive receptors	High	Negligible	Slight adverse (Not significant) (temporary, direct and short-term)	N/A	N/A
Noise pollution	Local population overall and all sensitive receptors	High	N/A	N/A	Minor adverse (one property on Maidstone Road) Negligible (82 residential receptors and 1 non-residential receptor)	Slight adverse (Not significant) (permanent, direct and long-term)
Noise pollution	Local population and all sensitive receptors	High	N/A	N/A	Minor beneficial (12 residential receptors and 1 non-residential receptor) Negligible (14 residential receptors)	Slight beneficial (Not significant) (permanent, direct and long-term)
Noise pollution	Local population and all sensitive groups	High	N/A	N/A	Moderate beneficial (7 residential receptors in Stockbury Valley)	Moderate beneficial (Significant) (permanent, direct and long-term)

Activity	Baseline		Construction		Operation	
Wider health determinant	**Receptor**	**Receptor sensitivity**	**Impact magnitude**	**Significance of effects**	**Impact magnitude**	**Significance of effects**
					Major beneficial (2 residential receptors in Stockbury Valley)	Large beneficial (Significant) (permanent, direct and long-term)
Noise pollution	Local population and all sensitive groups	High	N/A	N/A	Moderate beneficial (NIAs 4574/4575)	Moderate beneficial (Significant) (permanent, direct and long-term)
Noise pollution	Local population and all sensitive groups	High	N/A	N/A	Negligible (Other NIAs and other residential properties in wider study area)	Slight adverse (Not significant) (permanent, direct and long-term)

Summary of significant and residual effects

13.10.117 During construction and to accommodate the Scheme:

- Permanent land take (438 m^2) and demolition of one residential unit ('The Gate House') is required for a new section of road to be built. Whilst the loss of this property will be permanent and irreversible for the residents, it is an essential part of the Scheme to facilitate the buildability of the Scheme and maintain traffic flow from Maidstone Road and Oad Street to the Stockbury roundabout, throughout the construction phase. It is therefore included within the Scheme boundary, Side Roads Order as Improved Highway, and the Compulsory Purchase Order. It is understood that discussions are ongoing between Highways England and the occupiers of The Gate House to agree compensation that would minimise the effects of the loss of the property and minimise any potential effects on human health.
- Permanent loss of land (1,012 m^2) is required to construct a new access to Bowl Reed. This loss will be permanent and irreversible; however, it is an essential part of the Scheme to mitigate safety impacts at the Maidstone Road / Oad Street Junction and has therefore been included within the Scheme boundary, Side Roads Order as a Private Means of Access, and Compulsory Purchase Order. The land is required to create a new private means of access and grant private rights of way to Bowl Reed following the closure of the current access. The new private means of access has been agreed with the residents and will be of equal or better provision than existing.
- However, whilst significant adverse effects are predicted for The Gate House and at Bowl Reed, the effects are considered small scale so does not constitute overall significant adverse effects on private residential properties as a whole in the core study area which comprises 3,912 households.

13.10.118 During operation:

- Significant beneficial noise effects would occur during operation at two Noise Important Areas (NIA's) and residential properties in Stockbury Valley in the long- and short-term due to the change in the road alignment both horizontally and vertically and noise mitigation measures incorporated into the design.
- Significant beneficial amenity effects are likely for NMU following the closure of Honeycrock Hill to vehicles and creation of new PRoW facilities, linking Honeycrock Hill to Church Hill junction to the north and the A249 roundabout to the east.
- Significant beneficial effects are likely for families with children and adolescents and people who are physically or mentally disadvantaged through reduced risk of injuries and death.

13.11 Cumulative effects

13.11.1 This population and human health chapter is by nature an in-combination assessment of the population and human health impacts resulting from environmental effects of the Scheme. The full scope of expected impacts on the

health determinants and ultimately on human health has been covered in the assessment.

13.11.2 Cumulative effects of the Scheme and other developments have been incorporated into the findings of the technical chapters on which this assessment is based and are hence included in the assessment. Any significant in-combination effects relating to the other environmental topics is discussed in Chapter 15, Assessment of Cumulative Effects.

Construction

13.11.3 There are four consented schemes within the study area (Land at Woodgate Lane, Builders Yard Woodgate Lane, Land at Wises Farm, and Manors Farm) which, when combined with the Scheme, could cumulatively affect identified sensitive receptors during construction. Two of these schemes are within the core study area used to assess the effects on population and human health.

13.11.4 It is anticipated that during construction there will be an increase in construction traffic, dust and pollution generated, and additional urbanising features introduced into the landscape by the consented schemes, which could have adverse impacts on the amenity, health and safety of population and human health at sensitive receptors near Land at Woodgate Lane and Builders Yard on Woodgate Lane in the core study area. However, any effects would be temporary and can be suitably mitigated by the application of standard and appropriate mitigation. These effects will be of limited duration and intensity and would impact a low number of people. Therefore, the likely cumulative effects on population and human health during construction, such as from air pollution, noise and vibration, and risk of injuries and death will be negligible. The assessment of the Scheme itself identifies no significant residual amenity or human health effects. Furthermore, the planning applications for the proposed developments would have been required to demonstrate that planned development is suitable for the intended use and that mitigation and control measures will be adopted during the construction phase in respect to soil pollution and/or water pollution, therefore, there is little scope for cumulative effects.

Operation

13.11.5 The local area and local economy would likely see a positive cumulative effect from the consented schemes which include a mix of residential dwellings, employment, retail, school, and recreational facilities with associated access, car parking and landscaping. This will have minor beneficial effects for the health and social wellbeing of local communities via the provision of much needed housing and community infrastructure in a core and wider area, where there are known to be barriers to housing and deprivation in the living environment.

13.1 Monitoring

13.11.6 No monitoring specifically related to population and human health is considered necessary.

13.11.7 Monitoring suggested in other topic chapters may be relevant to receptors in the population and human health chapter, particularly around human health and amenity.

13.2 Summary

13.11.8 Overall the Scheme is likely to have a range of effects on population and human health in the vicinity. There will be significant, irreversible effects on residents at The Gate House with permanent land take and demolition of the residential property and residents at Bowl Reed through permanent land take. However, the effects are not considered to represent an overall significant adverse effect on private residential properties as a whole in the core study area which comprises 3,912 households.

13.11.9 Once operational, some adverse effects may remain, however some receptors will receive benefits from the Scheme, particularly NMU, residential properties in Stockbury Valley and two Noise Important Areas (NIAs). There will be reduced risk of injury and death for families with children and adolescents and people who are physically or mentally disadvantaged.

13.11.10 By design year 15, remaining adverse effects such as vegetation loss and reduction in visual amenity are anticipated to be minimised when mitigation planting becomes established, however some slight adverse effects on visual amenity may remain.

14. Climate change

14.1.1 The Climate Change chapter is presented in two separate sub-chapters:

- Effects of the Scheme on climate; and
- Vulnerability of the Scheme to climate change.

Effects of the Scheme on climate

14.1 Introduction

14.1.1 This chapter details an assessment of the Scheme's effects on climate during construction and operation.

14.1.2 The Scheme has the potential to affect the earth's climate by the emission of greenhouse gases into the atmosphere, which will occur during construction and throughout its operational life. The earth absorbs energy from the sun and re-emits it as thermal infrared radiation. Greenhouse gases in the atmosphere absorb this radiation, preventing it from escaping into space. The higher the concentration of greenhouse gases, the more heat energy is retained, and the higher global temperatures become. Due to human activities, the concentration of greenhouse gases in the atmosphere has increased dramatically, leading to global warming. This leads to myriad indirect impacts as the climate responds to the increased atmospheric temperature.

14.1.3 This chapter addresses the part of the climate change requirement outlined in The Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (SI 2015/517) (herein referred to as the 'EIA Regulations 2017'), which states that the assessment should consider the potential effects of the Scheme on climate, in particular the magnitude of greenhouse gases emitted during both construction and operation.

14.2 Competent expert evidence

14.2.1 This effects of the Scheme on climate section has been undertaken by Jon Casey who is a qualified Principal Environmental Consultant (BA (Hons) Environmental Studies, BSc Environmental Resources) and holds professional membership with the Institution of Environmental Sciences. He has over 15 years of knowledge and experience in infrastructure sustainable design and carbon management and has used his knowledge and professional judgement to undertake this assessment**.**

14.3 Legislative and policy framework

Table 14.1: Legislation, regulatory and policy framework for effects on climate

Scale	Legislation/regulation	Summary of requirements
National	Town and Country Planning (Environmental Impact Assessment) Regulations 2017	The requirement to consider a project's effects on climate change has resulted from the 2014 amendment to the EIA Directive (2014/52). The Directive has been fully transposed into UK law in the Town and Country Planning

Scale	Legislation/regulation	Summary of requirements
		(Environmental Impact Assessment) Regulations and came into force in the UK on the 16th May 2017. The Directive requires: "A description of the likely significant effects of the project on climate (for example the nature and magnitude of greenhouse gas emissions)."
	National Planning Policy Framework (NPPF) 2019	The NPPF includes the mitigation of climate change as part of its overarching objectives for achieving sustainable development. It provides that the planning system should support the transition to a low carbon future, shaping places in ways that contribute to radical reductions in greenhouse gas emissions. This includes supporting low carbon infrastructure.
	National Networks National Policy Statement (NN NPS)	With relevance to this chapter, the NPSNN (2014) highlights that the impact of road improvements on aggregate emission levels is likely to be small. However, it requires that applicants should both provide evidence of the carbon impacts of a proposed Scheme and undertake an assessment of the Scheme against the Government's carbon budgets. This will be implemented through the methodology presented below.
	Road Investment Strategy (RIS) and Strategic Business Plan 2015	The Government's Road Investment Strategy will see £15.2 billion invested in over 100 road schemes between 2015 and 2021 (DfT, 2014b). Of this total, some £300 million has been allocated to address issues including flooding, carbon emissions, landscape and biodiversity.
	Road Investment Strategy: for the 2015/16 – 2019/20 Road Period	The Road Investment Strategy (2015), as amended in 2016, published by the Department for Transport, sets out the strategy for the transformation of the strategic road network (SRN) by 2040 to create a modern SRN that supports a modern Britain. The Strategy also specifies objectives to significantly reduce emissions across the SRN, including emissions reductions from SRN construction activities. The Scheme should support implementation of the strategy delivering carbon requirements specified as relevant to it.
	Highways England: Strategies and Frameworks	Highways England has a range of strategies, frameworks and tools in place for carbon reduction, including carbon objectives in their Sustainable Development Strategy (2017), and the Highways Agency Carbon Routemap (2014). Such strategies, frameworks and tools provide emission (i.e. carbon) projections and are intended to enable options to be considered. The Scheme should support the implementation of the strategies, frameworks and tools by delivering mitigation measures of relevance to the Scheme.

Scale	Legislation/regulation	Summary of requirements
	Highways Agency Carbon Routemap: opportunities for a national low carbon transportation system (2014)	The Highways Agency Routemap covers the direct and indirect emissions associated with the Agency's organisational activity, the highway asset base and associated supply chain, and those arising from the use of the network by customers. It presents potential emissions scenarios based on different levels of take-up of low carbon technologies and practices by the Highways Agency, and highlights opportunities available for creating a low-carbon transport scheme.
	Climate Change Act 2008	The Climate Change Act (2008) creates a new approach to managing and responding to climate change in the UK. The Government has established legally binding carbon reduction targets through the Climate Change Act (2008) to drive the reduction requirements required by the Kyoto Protocol, as set out in Table 14.2. The overall objective is to reduce emissions by at least 80% of the 1990 base level year by 2050.
	The Carbon Plan (Department of Energy and Climate Change (DECC), 2011	The Carbon Plan (2011) sets out how the UK will achieve the emissions reduction commitment of 80% by 2050, made in the Climate Change Act (2008). It sets out how the UK will make the transition to a low carbon economy, maintain energy security and minimise costs to consumers. The Plan does not relate directly to road improvement schemes, but the Scheme should support implementation of the plan by prioritising low carbon materials and construction and operational energy efficiency, where practicable.
	Construction 2025 (July 2013) HM Government	Construction 2025 (2013) sets out how efficiency improvements will be created in construction covering sustainability and carbon and including a target to reduce emissions by 50%. The emissions reduction target of 50% is not scheme specific, and the efficiency improvements are broad. In terms of the Scheme and emissions reduction, the reduction target should be taken into account when developing Scheme specific mitigation measures, where relevant.
	Infrastructure Carbon Review (2013) HM Treasury	The Infrastructure Carbon Review sets out carbon reduction action required by infrastructure organisations that have formally endorsed the review; this includes Highways England. The Review shows that the infrastructure industry controls 16% of the UK's total carbon emissions, covering construction (A1-5), and operation and maintenance of assets (B1-8). It also highlights that a further 37% of carbon emissions are related to the use of infrastructure assets (B9), over which the industry can have some influence.

Scale	Legislation/regulation	Summary of requirements
Local	Kent County Council: Environment Policy and Targets	Kent County Council's Environment Policy includes a commitment to: • Reduce carbon dioxide emissions related to its corporate estate, reducing emissions by 32% by 2021. With particular reference to this chapter, it specifically refers to street lighting. • Make sure its estate and services are adapted to the future impacts and opportunities of climate change.
	Kent County Council: Environment Strategy	The purpose of the Environment Strategy (2016) is to set out the high-level priorities for Kent in terms of environment and related health and economic outcomes. It recognises the major role of transport infrastructure, and specifically includes identification of the significant negative impact of carbon dioxide emissions from transport in Kent. The Environment Strategy includes priorities to address carbon dioxide emissions from transport.
	Kent County Council: Environment Strategy Implementation Plan	The Environment Strategy Implementation Plan (2017) sets out the specific activities to implement the Strategy summarised above. The Scheme should take into account the principles and requirements of the Plan when specifying mitigation measures of relevance to the Scheme.
	Bearing Fruits 2031: The Swale Borough Local Plan	The Local Plan, prepared in 2017, states the borough council's aims to reduce emissions, and identifies that transportation plays an important role in the success of strategies. Policy ST 1 states that the council will promote sustainable design and construction and the management of emissions. Policy DM 19 describes the council's policy on ensuring development proposals incorporate the reduction of carbon emissions over the long-term.

Table 14.2: UK carbon reduction targets

Carbon budget	Carbon budget level	Reduction below 1990 levels
3rd carbon budget (2018 to 2022)	2,544 $MtCO_2e$	37% by 2020
4th carbon budget (2023 to 2027)	1,950 $MtCO_2e$	51% by 2025
5th carbon budget (2028 to 2032)	1,725 $MtCO_2e$	57% by 2030

Table Source: UK Government Carbon Reduction Targets 2008

14.4 Study area

14.4.1 The study area has been defined according to Highways England guidance, and covers the emission of greenhouse gases resulting from the Scheme in its construction and operational phases, as well as opportunities for emissions reduction. The study area is not limited to the geographic extent of the Scheme

itself, as many emissions will result from upstream and off-site activities such as materials production.

14.4.2 The activities for which emissions have been quantified in the assessment include the direct supply chain activities for the 'Do Something' scenario of the Scheme's life cycle, for both the construction and operational stages of the Scheme. The specific elements of the Scheme lifecycle, referred to as modules, included in the assessment boundary are listed in Table 14.3 and Table 14.5. The 'Scheme boundary' specifies the life cycle, spatial and/or temporal extent of the quantification for each life cycle module, and the 'emissions scope' defines the source of emissions considered, including direct or supply chain emissions.

14.4.3 The life cycle modules listed in Table 14.4 and Table 14.6 have been excluded from the assessment on the basis that the associated emissions are either negligible, or the module is not applicable to the Scheme.

14.4.4 The emissions boundaries are in line with the boundaries set out in PAS 2080:2016 'Carbon Management in Infrastructure', which is the technical standard for measuring and managing emissions from infrastructure.

14.4.5 The timescale of the assessment covers:

- Construction, as a single time period;
- Total annual operation for the Opening Year (2022); and
- Total annual operation for the Design Year (2037).

Construction

Table 14.3: Scheme emission boundary and emission scope

Life cycle module	Scheme boundary		Emissions scope
Materials	The boundary covers the use of construction materials within the construction site boundary and the supply chains associated with these. Consumables are excluded as they are small, and plant is excluded on the basis of shared use across schemes.		The emissions scope accounts for primary raw material extraction, manufacturing and intra-manufacturing transportation, as captured in the relevant emissions factor values.
Transport	The boundary covers transportation of the construction materials and the distances travelled from the primary site of manufacturing, not the supply depot. The primary site of manufacturing is used because transportation from a local supply depot does not represent the realistic transportation emissions, so can lead to significant under reporting.		The emissions scope considers direct vehicle emissions.
Construction	Construction plant use	The boundary for construction plant covers the plant quantities, sizes and operating hours within the Red Line Boundary.	The emissions scope considers well-to-tank and direct plant emissions, according to engine on-time, engine size, hours of operation.

Life cycle module	Scheme boundary		Emissions scope
process	Construction water use	This boundary covers mains water use only within the Red Line Boundary.	The emissions scope considers emissions from all activities for the treatment and supply of water to site.
	Construction waste transportation	The boundary covers transportation of bulk construction waste and the distances travelled from the construction site to the primary processing site.	The emissions scope considers direct vehicle emissions.
	Construction waste off-site processing	The boundary covers processing of bulk construction waste and is the same as quantified in the waste assessment (Chapter 12 Materials and Waste).	The emissions scope considers emissions from all waste processing activities.
	Employee commuting	The boundary includes transportation of workers to the site for the duration of the construction works.	The emissions scope considers direct vehicle emissions.

Table Source: Interpreted Highways England guidance and from PAS 2018:2016.

Table 14.4: Exclusions from construction Scheme emissions boundary

Life cycle module	Reasons for exclusion
Preliminary studies and consultations	This module includes a very wide range of office activities and travel from a wide range of locations. Emissions for this life cycle stage are minimal in comparison to both construction and in-use emissions and it is therefore excluded from the assessment.

Operation

Table 14.5: Operation scheme emissions boundary

Life cycle module	Scheme boundary	Emissions scope
Road user carbon	The boundary includes traffic use of the infrastructure within the red line boundary for the Scheme, and also traffic use of the wider road network, as outlined in the air quality assessment (Chapter 5 Air Quality).	The emissions scope considers direct vehicle emissions.
Maintenance / refurbishment	This includes ongoing maintenance, repair, replacement and refurbishment activities.	Project-specific data is not available for a calculation to be undertaken. Therefore, operation and maintenance emissions are estimated using the same methodology as for the Scheme Emission Baseline (i.e. applying a typical percentage of in-use traffic emissions).

Life cycle module	Scheme boundary	Emissions scope
Operational energy use	The boundary for operational energy includes the electricity and direct fossil fuel consumption for operation of the infrastructure within the red line boundary for the Scheme, over the planned operational life-time of the Scheme.	Project-specific data is not available for a calculation to be undertaken. Therefore, operation and maintenance emissions are estimated using the same methodology as for the Scheme Emission Baseline (i.e. applying a typical percentage of in-use traffic emissions).

Table Source: Interpreted from Highways England guidance and PAS 2080:2016

Table 14.6: Exclusions from operation Scheme emissions boundary

Life cycle module	Reason for exclusion
Direct operational emissions	This only covers emissions from the infrastructure itself whilst in use, e.g. from paint. It does not include emissions from traffic, nor does it include energy use, both which are accounted for elsewhere. Direct emissions from the infrastructure itself will be negligible and are therefore excluded from this assessment.
Operational water use	There is no specific water use for the operation of the Scheme, and it is therefore excluded from the assessment.
Other operational processes	There are no operational processes relevant to the Scheme emissions other than the use of the Scheme by traffic and infrastructure energy. This module is therefore excluded from the assessment.
End of life stages	There are no plans to decommission the Scheme, so no end of life activities will take place. This module is therefore excluded from the assessment.
Offsetting	Carbon offsetting – including vegetation for sequestration, solar PV for electricity export, or financial support of low-carbon projects – is specifically excluded from the study. Any carbon savings achieved through offsetting should be reported separately.

14.5 Assessment methodology

Proposed level and scope of assessment

14.5.1 There is currently no specific guidance in the Design Manual for Roads and Bridges (DMRB) for assessing the effects of this type of scheme on climate. A proportionate approach has been adopted which focuses on defining the principal contributing factors to the effects on climate and quantifying the magnitude of emissions.

Emissions quantification goal

14.5.2 The goal of the emissions quantification exercise is to calculate the emissions anticipated to be generated by the Scheme (according to the Scheme boundary and emissions scope set out in Section 14.4). The purpose of this is to:

- Determine the magnitude of the Scheme's emissions, for the relevant scenarios;
- Enable comparison of the ‘Do Something’ scenario against the ‘Do Minimum’ scenario and UK carbon reduction targets; and

- Enable identification of emissions hot spots within the 'Do Something' scenario to inform identification and prioritisation of further appropriate mitigation measures.

Calculation methodology

14.5.3 The Scheme emissions have been quantified by calculation, using project data from the emerging design and relevant carbon conversion factors. Different greenhouse gases have different global warming potentials, and to account for this they have been reported throughout this assessment as their carbon dioxide equivalent (CO_2e) value.

14.5.4 Emissions calculations are undertaken using the following methodology:

- Individual calculations are carried out for each item or activity (or sub-part thereof) included in the Scheme boundary using relevant project data, to determine the size of the item or activity in appropriate units of measurement, e.g. for a concrete kerb stone:
  - Length (m) x width (m) x depth (m) x density kg/m^3 = kg/kerb stone; or
  - A direct unit value is used if available, e.g. kg/kerb stone.
- The individual item or activity values are then multiplied by the associated carbon conversion factors to determine total emissions per unit, e.g.
  - kg/kerb stone x $kgCO_2e$/kg for concrete = $kgCO_2e$/kerb stone.
- The emissions per item or activity are multiplied by the total number of items or activities to quantify the total emission for the total number of items or occurrences of an activity, e.g.
  - $kgCO_2e$/kerb stone x number of kerb stones = total $kgCO_2e$ emissions for kerb stones.
- The total emissions for a scheme are quantified by summing the calculations for the individual items and activities (e.g. sum of total emissions, for kerb stones, asphalt, plant use, direct vehicle use, etc).

14.5.5 For the construction stage of the Scheme, calculations have been undertaken by using Highways England's Carbon Tool, which will allow comparison of the results to other highway scheme assessments using the same tool. The Carbon Tool is spreadsheet-based, and provides space to input material and non-material construction information under the following categories:

- Bulk materials;
- Earthworks;
- Fencing, barriers and road restraint systems;
- Drainage;
- Road pavements;
- Street furniture;
- Civil structures and retaining walls;
- Fuel, electricity and water use;

- Business and employee transport; and
- Waste.

14.5.6 The Tool then uses a range of pre-programmed materials data (e.g. mass) and carbon factors to calculate an itemised and overall emissions total.

14.5.7 Operational emissions are calculated separately from the Carbon Tool, which is focused specifically on construction-phase emissions. Road user carbon emissions have been modelled in accordance with DMRB, Volume 11, Section 3, Part 1 Air Quality: HA 207/07.

14.5.8 There are no project-specific data available for operational energy use, or maintenance and refurbishment during the Scheme's operational life, so emissions cannot be calculated using the above methodology. Instead they have been estimated using published data from other highways schemes, based on the assumption that emissions from the operation and maintenance of similar highways is broadly consistent across the UK road network.

Data collection

14.5.9 The data for the assessment has been obtained from the design team and contractor. Table 14.7 summarises the specific data collected for each life cycle, and the emissions factors used.

Table 14.7: Data collection methodology

Life cycle module	Data source
Materials	Temporary and permanent construction materials data have been provided by the design team based on the current Scheme design. Where the design is not finalised, assumptions were made by engineering specialists based on professional judgement. The carbon factors for materials integral to the Highways England Carbon Tool were used.
Transport	At this stage the specific sources of materials are not known. It has been assumed that all materials have been transported an average distance of 200 km. The carbon factors for materials integral to the Highways England Carbon Tool were used.
Construction processes	Construction Plant Use Diesel use by construction plant was estimated based on data generated for other, similar highway schemes. The carbon factors for different fuels integral to the Highways England Carbon Tool were used. Construction Water User Water use during the construction process was estimated by the contractor based on experience from a similar scheme. The carbon factor for mains water use integral to the Highways England Carbon Tool was used. Construction Waste Waste quantities were provided by the design team. At this stage data on the distance that the waste is due to be transported is not available and is therefore assumed based on the proximity principle. The waste treatment / disposal options have been estimated as part of the waste assessment (Chapter 12 Materials and Waste).

Life cycle module	Data source
	The carbon factors for waste integral to the Highways England Carbon Tool were used. Employee Commuting The assumption for numbers of workers and distance travelled was made by the contractor. The carbon factors for travel integral to the HE Carbon Tool were used.
Road user carbon	Modelled in accordance with DMRB, Volume 11, Section 3, Part 1 Air Quality: HA 207/07. This uses emission factors provided by Defra in the Emissions Factors Toolkit v8, which makes assumptions about the makeup of future fleets based on Department for Transport projections. This allows for predicted uptake of electric and hybrid vehicles as well as conventional vehicles (petrol and diesel).
Operation and maintenance	Emissions have been estimated using published data from other highways schemes, based on the assumption that emissions from the operation and maintenance of similar highways is broadly consistent across the UK road network as a proportion of road user emissions.

Table Source: Interpreted from PAS 2080:2016.

Emissions analysis and significance comparison

14.5.10 There is no accepted technical or policy guidance on how to determine the significance of a project's effects on climate. However, the National Networks National Policy Statement (NN NPS) acknowledges that the emissions from the construction and operation of a road scheme are likely to be negligible compared to total UK emissions, and are unlikely to materially impact the UK Government's ability to meet its carbon reduction targets. The NN NPS specifically states that *'it is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets'.* Based on this, it is considered unlikely that the Scheme's emissions will be of a quantity great enough to cause a significant effect on climate.

14.5.11 However, due to the global scale, long-term duration and cumulative and irreversible nature of the impact, the effects on climate of the Scheme are still considered important. Highways England is committed to reducing emissions where practicable, and therefore emissions have been quantified and presented as part of the Environmental Statement.

14.6 Assumptions and limitations

14.6.1 Where assumptions have been made, they have been selected to present the worst-case scenario for that particular item/factor.

14.6.2 Assumptions/judgements in each case have been made from either:

- Emerging design detail;
- Engineering specialist knowledge;
- Environmental specialist knowledge;
- Climate change/carbon specialist knowledge;
- Manufacturer specifications; or

- Proxy engineering data from previous projects.

Materials

14.6.3 The materials and quantities listed in Table 14.8 were included in the assessment. This is the complete list of materials provided by the design team. Materials are presented in the units they were input into the Carbon Tool.

Table 14.8: Construction materials

Category	Item	Type	Unit	Quantity
Bulk Materials	Ready mix concrete	C8/10	m^3	30,500
		C32/40	m^3	1,600
		C40/50	m^3	2,118
	Reinforcement steel	Steel bar and rod	tonnes	493
	Fill and aggregate	Recycled imported fill/aggregate	tonnes	151
		General fill/aggregate	tonnes	16,200
	Asphalt	General asphalt	tonnes	60,000
Earthworks	Geotextiles	Polypropylene geotextile / matting	m^2	187,484
Fencing, Barriers & Road Restraint Systems	Fence	Steel/wire/chain fence (includes posts)	metres	2,250
	Noise barriers	Steel barrier 2m	metres	200
	Road Restraint System/ Safety Barrier	Steel RRS barrier single sided	metres	4,816
		Steel RRS barrier double sided	metres	365
		Pre-cast concrete step barrier	metres	2,091
Drainage	Plastic pipework (HDPE)	150mm diameter	metres	758
		225mm diameter	metres	2,000
		300mm diameter	metres	4,000
		450mm diameter	metres	7,500
		600mm diameter	metres	300
	Precast concrete circular pipework	900mm diameter	metres	200
	Precast concrete manholes	1800mm diameter, up to 3m depth	no.	180
		2400mm diameter, up to 3m depth	no.	4

Category	Item	Type	Unit	Quantity
	Precast concrete inspection chambers	600mm diameter, up to 1.2m depth	no.	60
	Plastic inspection chambers	600mm diameter, 1.2m-3m depth	no.	7
	Gullies	Plastic gully pots - PVC	no.	185
	Channel & slot drains	Precast concrete channel (heavy duty)	metres	4,000
	Headwalls	Concrete	no.	21
	Damp proof course and impermeable membrane	Polyethylene	m^2	1,922
Street Furniture & Electrical Equipment	Road lighting and columns	LED light	no.	68
		Steel columns 8m	no.	10
		Steel columns 10m	no.	52
		Steel columns 12m	no.	2
	Cable	Armoured cable / power cable	metres	9,500
	Cabinets	Any type	no.	2
Civils Structures & Retaining Walls	Formwork / shuttering	Plywood	m^3	34
		Plastic formwork (disposable)	tonnes	53
	Piling	Pre-cast concrete piles	tonnes	1
	Pre-cast concrete	General concrete	tonnes	0.1
	Bricks and blockwork	Concrete blocks (includes mortar)	no.	57,827

Transport

14.6.4 Information relating to where materials will be sourced from is not yet available, as this will be determined at a later date by the contractor. An assumed 200 km travel distance has been applied based on previous experience by specialists of materials transportation for infrastructure schemes including highway schemes (for example, see Table 14.10). The emission factor used for transportation is based on a heavy goods vehicle having an assumed average load.

Construction process

14.6.5 The construction period has been approximated at 18 months, based on the

Buildability Report provided by the contractor. Working days are assumed to be 10 hours per day, 5 days per week, with 10 days holiday per year.

14.6.6 Quantities of diesel used by construction plant have been estimated by the contractor at 5,000 m^3 based on other, similar, highway schemes.

14.6.7 Water use was estimated by the contractor to be 7,500 m^3 for the Scheme, based on experience of other, similar, highway schemes.

14.6.8 In a similar way, the electricity use for the construction phase has been estimated to be 68,500 kWh.

14.6.9 Waste is assumed to be transported 50 km, as specific details are not available at this stage of the project. As above, 50 km is based on previous experience by specialists. It is considered likely that waste will be dealt with within 50 km to adhere to the proximity principle. The waste transport has been assumed to be a heavy goods vehicle having an assumed average load. The disposal method 'landfill' has been selected as a worst-case, in the absence of information from the contractor. Table 14.9 below presents the data used to calculate emissions from waste transport and processing.

Table 14.9: Construction Waste

Waste	Disposal Method	Quantity (tonnes)
Aggregate and soil exported off-site	Landfill	482,483
Concrete	Landfill	4,207
Asphalt	Landfill	3,540
Steel	Landfill	27

14.6.10 Employee commuting was estimated by the contractor and has been based on 150 people working at any one time, with 60% of the workforce travelling 40 km each way, 5 days per week, and 40% travelling 100 km each way, once per week.

Maintenance and refurbishment

14.6.11 There is no operational energy use or maintenance and repair data available for the 'Do Something' scenarios. However, the emissions can be considered to be proportionally similar to the Operation + Maintenance per annum CO_2e ($OpCO_2e$) levels of other highways schemes as defined in Table 14.10 on the basis that operation, maintenance and use of highways is sufficiently consistent across the UK road network.

Table 14.10: Typical highway scheme emissions

Carbon footprint life cycle modules	Project / length and width component							
	M4 corridor around Newport	A14	A465	HA project A	HA project B	HA project C	HA project D	HA Project E
	23km New relief road	37km improvement scheme	7.8km embankment section	26.6km widening of A road	6.5km single to 2 lane dual carriageway	4km upgrade of existing junction	0.7km Refurbished existing viaduct	22.1km Upgrade from dual to 3 lanes
CapCO_2e (tCO_2e)								
Material	436,600	740,100	44,300	74,500	77,300	36,100	5,800	213,700
Labour + plant	42,800	243,800	5,800	38,500	27,500	8,200	4,000	20,900
Earthworks	43,200	n/a	2,500	n/a	n/a	n/a	n/a	n/a
Construction tCO_2e/km	21,800	26,600	6,700	4,300	16,100	11,100	13,900	10,600
OpCO_2e (tCO_2e)								
Operation + Maintenance/ annum	1,600	2,400	2,600	n/a	n/a	n/a	n/a	n/a
UseCO_2e (tCO_2e)								
Use/annum	2,268,700	4,386,400	882,000	n/a	n/a	n/a	n/a	n/a

Table Source: Welsh Government (2016). M4 Corridor around Newport, Environmental Statement: Volume 3, Appendix 2.4 Carbon Report.

14.6.12 The OpCO_2e levels defined in Table 14.10 show that proportionally, emissions for operational energy use and maintenance works equate to between 0.05 and 0.29% of in-use traffic emissions, as shown by the three schemes listed below:

- (Operation + Maintenance per Annum) / Use per Annum = Operational Proportion (%):
  - M4CaN: (1,600/ (1600 + 2,268,700)) x 100 = 0.07%;
  - A14: (2,400/ (2,400 + 4,386,400)) x 100 = 0.05%; and
  - A465: (2,600/ (2,600 + 882,000)) x 100 = 0.29%.

14.6.13 0.29% of road user emissions has been applied as a worst-case operation and maintenance figure.

14.7 Baseline conditions

14.7.1 The baseline conditions for the effects on climate are defined by the:

- Total background emissions from all sources, i.e. all UK emissions, at all scales; and
- Predicted total emissions occurring for both the Opening Year (2021) and the Design Year (2041), assuming the Scheme is not constructed, i.e. the 'Do Minimum' scenarios.

National emissions baseline

14.7.2 It is estimated that total global greenhouse gas emissions from all sources currently amount to approximately 50 billion tonnes of CO2e[379]. However, it is not considered representative to compare any UK scheme against this, as any scheme will always be negligible. Instead, it is considered most appropriate to use the national baseline for comparison as its magnitude is more relevant and UK specific. The total UK emissions for 2016 (the last reported year) were 467.9 million tonnes of CO2e[380]. The breakdown of this by sector, by final user is shown in Table 14.12.

Table 14.11: UK national emissions (2016)

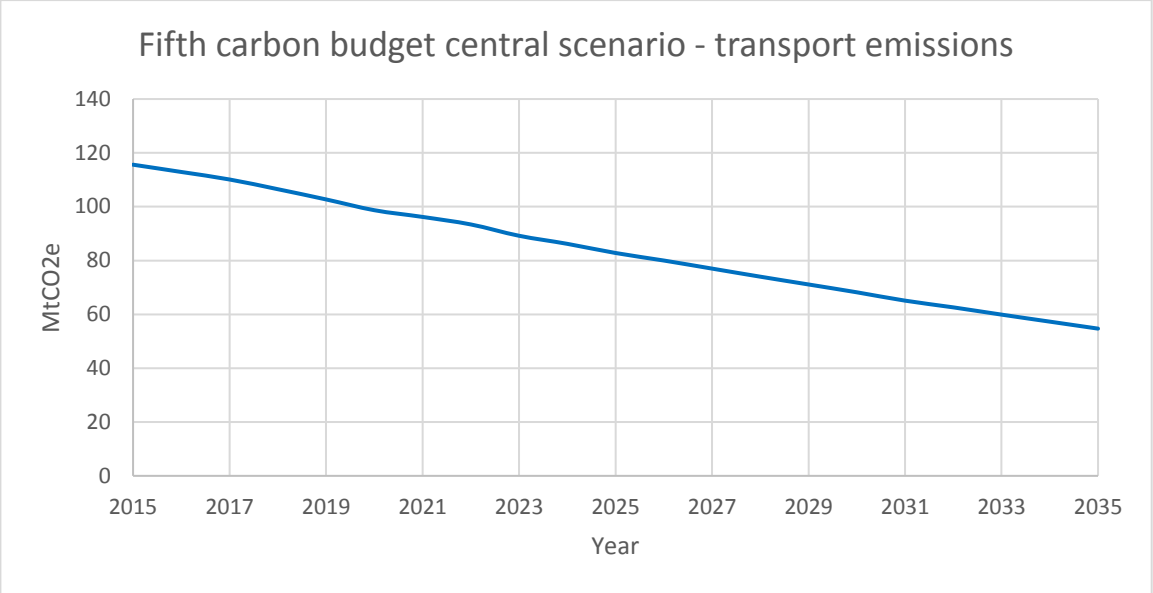
Sector (by final user)	Emissions (million tonnes of CO_2e)	% of total
Transport	125.8	26.9%
Energy supply	120.2	25.7%
Business	81.5	17.4%
Residential	69.8	14.9%
Agriculture	46.5	9.9%
Waste management	19.9	4.3%
Industrial processes	10.5	2.2%
Public	8.2	1.8%
Land use, land use change and forestry (LUKUCF)	-14.6	-3.1%
Total	467.9	100%

Table Source: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/680473/2016_Final_Emissions_statistics.pdf

14.7.3 The dataset for the fifth UK carbon budget central scenario includes forecasts of emissions for different sectors. Figure 14.1 below presents the annual reduction in transport sector emissions (including shipping and domestic aviation) required to support the achievement of the carbon budgets.

[379] http://themasites.pbl.nl/publications/pbl-2017-summary-trends-in-global-co2-and-total-greenhouse-gas-emissions-2983.pdf
[380] www.UK.gov 2017 Final UK greenhouse gas emissions national statistics

Figure 14.1: Forecast UK Transport Sector Emissions



Source: adapted from the Fifth Carbon Budget Central Scenario Dataset (2016)

Scheme emission baseline

14.7.4 The calculated emissions for the 'Do Minimum' scenario regarding the Scheme cover the following life cycle modules:

- Road user carbon emissions;
- Maintenance and refurbishment of the Scheme; and
- Operational energy use for the Scheme.

14.7.5 Only these life cycle modules are included as they are the only stages relevant to an operational highway.

Road user carbon

14.7.6 The road user carbon emissions for the 'Do Minimum' scenarios have been modelled in accordance DMRB, Volume 11, Section 3, Part 1 Air Quality: HA 207/07. They are as follows:

- 2022 Opening Year: 647,026 tCO_2e
- 2037 Design Year: 745,291 tCO_2e

14.7.7 The data show an expected 15% increase in emissions between the Opening and Design Years, due to an increase in vehicle kilometres travelled.

Operational energy use and maintenance

14.7.8 Applying 0.29% of road user emissions as a worst-case value, the Scheme's Do Minimum scenario emissions for operational energy use and maintenance can be estimated as:

- 2022 Opening Year: 647,026 x 0.29% = 1,876 tCO_2e
- 2037 Design Year: 745,291 x 0.29% = 2,161 tCO_2e

Total Baseline Emissions

14.7.9 Based on the addition of the above, the total Scheme baseline emissions for the Do Minimum scenarios are estimated to be as follows:

- 2022 Opening Year: 648,902 tCO_2e
- 2037 Design Year: 747,452 tCO_2e

14.8 Potential impacts

14.8.1 Climate is a wide-ranging and complex topic. In terms of potential sources of emissions, it covers the whole project life cycle and supply chain emissions from a variety of sources that will most likely include international locations. However, in comparison, the receptor and impact of effects on climate are very specific, as follows:

- There is only one receptor: the atmosphere, which is non site-specific;
- There is only one direct impact: global warming, which is also non site-specific; and
- The impacts of emissions are global in nature and so all units of CO_2e can be considered to have the same impact no matter where they are emitted.

14.8.2 These characteristics place the focus of the assessment of potential impacts on the sources and the quantity of emissions that are generated in comparison with the baseline. This is because it is the magnitude of emissions from each source, and in total, that defines the overall impact.

14.8.3 The construction stage of the Scheme would have an overall adverse effect on climate, as it would give rise to emissions. These emissions would arise from the production of materials to be used in construction, their transportation to site, and on-site through construction activities (for example from emissions from diesel-fuelled construction plant).

14.8.4 The operation stage of the Scheme would give rise to emissions from road users and operational energy use (for example street lights). However, whilst the operation of the Scheme would certainly cause emissions and therefore have a negative effect on climate, the Scheme may cause a reduction in emissions compared with the 'Do Minimum' Scenario, which would result in the Scheme presenting an improvement in effects on climate. The results of the assessment are presented in Section 14.11.

14.9 Design, mitigation and enhancement measures

14.9.1 Emissions have been, and will be, mitigated by applying Highways England's carbon reduction hierarchy:

- Avoid/prevent:
  - Maximise potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required; and
  - Explore alternative lower carbon options to deliver the project objectives (i.e. shorter route options with smaller construction footprints).

- Reduce:
  - Apply low carbon solutions (including technologies, materials and products) to minimise resource consumption during the construction, operation, user's use of the project, and at end-of-life; and
  - Construct efficiently, using techniques (e.g. during construction and operation) that reduce resource consumption over the life cycle of the project.
- Remediate:
  - After addressing steps 1 and 2, projects will identify, assess and integrate measures to further reduce carbon through on- or off-site offsetting or sequestration.

14.9.2 Specific potential mitigation measures relevant to the construction and operation stages of the Scheme are suggested below. The defined measures are consistent with PAS 2080:2016, the carbon management technical standard relevant to all infrastructure projects.

Construction

14.9.3 Mitigation measures that will be used to reduce emissions in the construction life cycle modules are shown in Table 14.12.

Table 14.12: Construction emissions mitigation measures

Life cycle module		Mitigation measures
Materials		Reduction of materials consumption will be carried out in accordance with the mitigation measures outlined in the Materials and Waste chapter (Chapter 12). In addition, consideration will be given to alternative low carbon materials e.g. recycled aggregates, cement substitution etc.
Transport		Materials transportation will be reduced and/or avoided by minimising the quantity of materials required, as per 'Materials' above. Additionally, where possible detailed design and procurement measures will be specified to minimise the necessity to source materials from long distances.
Construction processes	Construction plant use	Construction plant emissions will be minimised by designing for efficient construction processes as part of design development. During construction plant emissions should be managed via the Outline Environmental Management Plan (OEMP), which should specify plant operator efficiency requirements.
	Construction water use	Construction water consumption should be minimised by designing for efficient construction processes as part of design development. During construction mains water consumption will be managed via the OEMP, which should specify reduction and re-use measures.
	Construction waste transportation	Reduction of waste generation should be carried out in accordance with the mitigation measures outlined in the Materials and Waste chapter (Chapter 12).

Life cycle module		Mitigation measures
	Construction waste off-site processing	Suitable/ appropriate waste treatment/ disposal should be carried out in accordance with the mitigation measures outlined in the Materials and Waste chapter (Chapter 12).
	Employee commuting	Local contractors will be used where possible, reducing the distance driven by employees.

Operation

14.9.4 Operational emissions can be mitigated by designing a Scheme which minimises emissions from traffic and operational energy use. Mitigation measures that will be employed to reduce in-use emissions are shown in Table 14.13.

Table 14.13: Operation emissions mitigation measures

Life cycle module	Mitigation measures
Road user carbon	Mitigation of in-use emissions will be explored based on examination of traffic management scenarios over the network. Inclusion of Non-Motorised User (NMU) routes to encourage the utilisation of alternative means of transport and help to achieve the goal of creating a more integrated and sustainable transport network, whilst reducing emissions.
Maintenance and repair	The mitigation measures detailed in Table 14.12 for the construction stage are also application to ongoing maintenance and repair.
Operational energy use	Operational energy use should be minimised by designing for use of low energy lighting and traffic management systems, specification of controls that minimise on-time, and use of low carbon energy sources, where practicable.

14.10 Assessment of effects

14.10.1 This assessment presents the emissions calculated for the ‘Do Something’ scenario, a comparison against the ‘Do Minimum’ baseline, and assessment against UK Government carbon budgets.

‘Do Something’ Scenario Emissions

Construction

14.10.2 Construction phase emissions are broken down in Table 14.14. The Carbon Tool used to calculate the emissions is provided in Appendix K.1 in Volume 2. Emissions from the construction phase total 44,488 tCO_2e.

Table 14.14: Construction stage emissions

Category	Item	Materials		Transport	
		Emissions (tCO_2e)	Percentage of construction total	Emissions (tCO_2e)	Percentage of construction total
Bulk materials	Ready mix concrete	7,277	16%	3,595	8%
	Reinforcement steel	690	2%	22	0.05%
	Asphalt	4,560	10%	2,627	6%
	Fill and aggregate	85	0.2%	716	2%
Earthworks	Geotextile	608	1%	8	0.02%
Civil structures & walls	Formwork / Shuttering	154	0.3%	3	0.01%
	Piling	0.2	0.2%	0.04	0.0001%
	Pre-cast concrete	0.01	0.01%	0.004	0.00001%
	Concrete blocks	84	0.2%	40	0.1%
Drainage	Plastic pipework (HDPE)	328	1%	6	0.01%
	Precast concrete circular pipework	32	0.1%	8	0.02%
	Precast concrete manholes	256	1%	54	0.1%
	Precast concrete inspection chambers	6	0.01%	1	0.002%
	Plastic inspection chambers	9	0.02%	0.1	0.0002%
	Gullies	8	0.02%	0.2	0.0004%
	Channel & slot drains	108	0.2%	26	0.1%
	Damp proof course and impermeable membrane	5	0.01%	0.08	0.0002%
	Fence	26	0.1%	0.376	0.001%

Category	Item	Materials		Transport	
		Emissions (tCO_2e)	Percentage of construction total	Emissions (tCO_2e)	Percentage of construction total
Fencing & barriers	Noise Barriers	29	0.1%	0.876	0.002%
	Road Restraint System / Safety Barrier	664	1%	111	0.2%
Street furniture & electrical equipment	Road lighting and columns	26	0.1%	0.5	0.001%
	Cable	17.528	0.04%	0.308	0.001%
	Cabinets	0.616	0.001%	0.018	0.00004%
Total materials		14,973	34%	-	-
Total transport		-	-	7,220	17%
Fuel, energy & water		15,942	35%	183	0.4%
Business and employee transport		-	-	710	2%
Waste		844	2%	4,616	12%
Total construction processes		16,786	37%	5,509	14%
Construction phase total		31,759	71%	12,728	31%
Note that due to rounding, totals may not add to 100%.					

14.10.3 The largest magnitude of emissions (37%) is likely to arise from on-site construction processes, particularly from fuel used in construction plant. Emissions from the production of materials equates to 34% of the total, and transport of these materials totals 17% of emissions, with the largest contributions from concrete (16% for production and 8% for transport) and asphalt (10% for production and 6% for transport). Transport to facilitate construction processes equals 14% of total emissions.

Operation

14.10.4 Operational phase emissions for the Opening and Design Years are shown in Table 14.15.

Table 14.15: Operation stage emissions for 2022 and 2037

Life cycle module	Emissions (tCO_2e)	
	2022	2037
Road user carbon	645,876	748,832
Maintenance and operation	1,873	2,172
Total operation	647,749	751,001

Comparing 'Do Minimum' and 'Do Something' scenarios

14.10.5 As emissions from construction do not occur in the 'Do Minimum' scenario, it can be considered that the construction stage of the Scheme would have the effect of releasing an additional 45,374 tCO_2e into the atmosphere in the 'Do Something' scenario.

14.10.6 The calculated operation stage emissions for the 2022 and 2037 'Do Minimum' and 'Do Something' scenarios are compared below in Table 14.16.

Table 14.16: 'Do Something' and 'Do Minimum' operational emissions comparison

Life cycle module	Emissions (tCO_2e)					
	2022 Do Minimum	2022 Do Something	Difference	2037 Do Minimum	2037 Do Something	Difference
Total Operational Emissions	648,902	647,749	-1,153	747,452	751,004	+3,552

14.10.7 In the Opening Year, the Scheme will lead to a small reduction in operation emissions of 1,153 tCO_2e (0.2%) due to more free-flowing traffic and improvements in vehicle technology. In the Design Year, the Scheme will cause an increase of 3,552 tCO_2e (0.5%) due to increased vehicle kilometres driven.

Total UK carbon budget comparison

14.10.8 Highways England is committed to reducing greenhouse gas emissions wherever practicable and to supporting the UK Government in meeting its carbon reduction targets. Table 14.17 shows the proportion of the relevant carbon budgets that the Scheme would contribute. Table 14.18 shows how the Scheme compares as a proportion of the transport sector's annual emissions as forecast in the fifth carbon budget central scenario. This approximation assumes an even distribution of emissions across the 18-month construction period.

Table 14.17: Comparison of Scheme to UK Government carbon budgets

Project stage	Scheme tCO_2e per carbon budget period	Relevant carbon budgets	UK carbon budget tCO_2e	Scheme proportion of budget
Construction and Opening Year	44,488 – 1,153 = 43,335	3rd carbon budget period	2,544,000,000	0.0017%
Design Year Operation	3,552	Beyond 5th carbon budget period	Not yet published by UK Government	-

Table 14.18: Comparison of Scheme to UK Transport Sector Forecast Emissions

Project stage	Annual Scheme tCO_2e	Relevant Year	Forecast transport sector emissions[381]	Scheme proportion of forecast transport sector emissions
Construction and Opening Year	29,659 – 1,153 = 28,506	2022	93,400,000	0.03%
Design Year Operation	3,552	2037	Not yet published by UK Government	-

Significant effects

14.10.9 The construction and Opening Year operation of the Scheme is expected to contribute 0.0017% of the UK's 3rd carbon budget and in the Design Year, the Scheme will lead to a small percentage increase (0.5%) in the magnitude of emissions compared with the Do Minimum scenario. It is considered that this magnitude of emissions from the Scheme will not have a significant effect on climate, in line with the position set out in the NN NPS.

14.10.10 However, it is considered important to note that although the emission increases and decreases are shown as negligible against the UK national budgets, they will affect the UK's ability to meet its targets.

Residual effects

14.10.11 Due to the embedded nature of the mitigation measures proposed, some of which have already been incorporated into the design and some of which are yet to be incorporated, it is not practicable to complete a quantitative assessment of 'before' and 'after' mitigation. Rather, the assessment shows a snapshot of the current design.

14.11 Cumulative effects

14.11.1 As previously described, there is a single, global-scale receptor; the atmosphere. It is the excess of emissions from human activities all over the world that contributes to the overall effect on climate, not only local emissions. The effects of all greenhouse gas emissions are essentially cumulative; it is their concentration in the atmosphere, not the actual level of emissions, that determines the warming effect (i.e. it is the 'stock' rather than the 'flow' which is important). For these reasons, the impact of the Scheme must be considered in the context of overall emissions from the UK and globally, rather than in combination with other local developments. The emissions from the Scheme will contribute to the global *c*.50 billion tonnes of CO_2e released annually, described in Section 14.8.

[381] This assumes that the transport sector continues to emit 26.9% of the UK's total emissions, as in 2016, for the different budget periods

14.12 Monitoring

14.12.1 It is not possible to directly monitor greenhouse gas emissions. However, Highways England's Carbon Tool is designed to be populated on a quarterly/monthly return basis through the construction process. Completing this activity will allow tracking of construction emissions against those forecast in this assessment. For the operational phase, actual road user numbers could be modelled as per HA 207/07 to calculate emissions. Operational energy use data could be collected and converted into an emission figure, and maintenance works could be recorded and reported in the same way as the construction works, using the Carbon Tool.

14.13 Summary

14.13.1 This chapter assesses the effects of the Scheme on climate through quantifying likely emissions of greenhouse gases to the earth's atmosphere.

14.13.2 The 'Do Something' scenario will generate the following change in emissions over the 'Do Minimum' scenario:

- Construction: 44,488 tCO_2e
- 2022 Opening Year: -1,153 tCO_2e
- 2037 Design Year: 3,552 tCO_2e

14.13.3 The construction phase and Opening Year together contribute 0.0017% of the UK's 3rd carbon budget. This is not considered to be a significant impact. There is currently no budget for the period covering the Design Year, however the generated emissions are considered to be minor and also not significant.

14.13.4 At all stages, emissions will be mitigated as far as possible as Highways England is committed to reducing emissions wherever practicable and to support the UK Government in meeting its carbon reduction targets.

Vulnerability of the Scheme to climate change

14.14 Introduction

14.14.1 This chapter outlines the assessment of the vulnerability and resilience of the Scheme to climate change during construction and operation in accordance with Highways England guidance.

14.15 Competent expert evidence

14.15.1 This vulnerability of the Scheme to climate change section has been undertaken by Dr. Jo Parker who is a climate change and adaptation expert with 9 years' experience of climate change impact assessments. Jo has used her knowledge and professional judgement to complete this assessment. The chapter was reviewed by Dr Steven Wade, Associate Director in Climate Resilience. Dr Wade has a PhD in hydrology and more than 20 years' experience of climate change risk assessment.

14.16 Legislative and policy framework

Table 14.19: Legislation, regulatory and policy framework for vulnerability to climate change

Scale	Legislation/regulation	Summary of requirements
National	National Planning Policy Framework (NPPF) 2019	The NPPF develops a planning system that contributes to radical reductions in greenhouse gas emissions, minimises vulnerability and improve resilience; encourages the re-use of existing resources, including the conversion of existing buildings; and supports renewable and low carbon energy and associated infrastructure. The NPPF states that "New development should be planned for in ways that avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure.
	National Networks National Policy Statement (NN NPS)	Paragraph 4.41 states that new national network infrastructure should be typically long-term investments which should remain operational over 'many decades in the face of a changing climate'. Therefore, applications should 'consider the impacts of climate change when planning location, design, build and operation'. Paragraph 5.19 outlines the need for appropriate mitigation measures to be implemented in both design and construction.
	Climate Change Act (2008)	The UK passed legislation that introduced the world's first long-term legally binding framework to tackle the risks posed by climate change. The Climate Change Act (2008) created a new

Scale	Legislation/regulation	Summary of requirements
		approach to managing and responding to climate change in the UK, by: • Setting ambitious, legally binding reduction targets; • Taking powers to help meet those targets; • Strengthening the institutional framework; • Enhancing the UK's ability to adapt to the impacts of climate change; and • Establishing clear and regular accountability to the UK Parliament and to the developed legislatures. Key provisions of the Act in respect of climate change adaptation include a requirement for Government to report, at least every five years, on the risks to the UK of climate change, and to publish a programme setting out how these will be addressed. This Act also introduces powers for Government to require public bodies and statutory undertakers to carry out their own risk assessment and make plans to address those risks. The Adaptation Sub-Committee of the Committee on Climate Change will provide advice to, and scrutiny of, the Government's adaptation work.
	EIA Directive (2014/52) transposed into UK law in Town and Country Planning (Environmental Impact Assessment) Regulations (2017)	The requirement to consider a project's vulnerability to climate change has resulted from the 2017 amendment to the EIA Directive (2014/52). The Directive has been fully transposed into UK law in the Town and Country Planning (Environmental Impact Assessment) Regulations and came into force in the UK on the 16th May 2017. The Directive requires: "A description of the likely significant effects of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change."
	The Highways Agency Climate Change Adaptation Strategy and Framework (2009)	The Climate Change Act (2008) has led to modifications of standards for the national road network. The Highways Agency has committed to assessing the potential risks that climatic changes pose to the ongoing management, maintenance, improvement, and operation of the strategic road network. It will factor anticipated climatic changes into the delivery of their business and develop appropriate management and mitigation solutions to remove or reduce these risks.
	Highways England Climate Adaptation Risk Assessment Update (2016)	Highlights the work Highway England is doing to adapt to climate change. It also discusses the plans in place to address the risks identified through the risk assessment processes.

Scale	Legislation/regulation	Summary of requirements
	Highways England Sustainable Development Strategy (2017)	The Climate Change adaptation vision is for the UK "to become more resilient to future changes in climate, which may result in more frequent and severe weather events, it is important that we adapt our network and make effective investment decisions. Climate adaptation today is tomorrow's resilience."
Regional	Kent County Council: Environment Policy and Targets	Kent County Council's Environment Policy includes a commitment to ensure its estate and services are adapted to the future impacts and opportunities of climate change.
	Kent County Council: Environment Strategy (2016)	The purpose of the Strategy is to set out the high-level priorities for Kent in terms of environment and related health and economic outcomes. It includes priorities to address carbon dioxide emissions from transport and the issue of severe weather, heat and flooding.
	Kent County Council: Climate Local Kent	Climate Local Kent is a strategy for reducing emissions and increasing resilience to climate change. Target to assess services for risks and opportunities and build resilience to climate change into the council's work.

14.17 Study area

14.17.1 The vulnerability of key receptors of the Scheme to climate change will be assessed. The assessment considers both temporary and completed works within the project boundary such as roads and supporting infrastructure, including bridges, embankments, earthworks and drainage. Receptors also include environmental receptors such as water quality and ecological receptors, as well as road users and maintenance/operational staff.

14.17.2 Climate change projections have been sourced from United Kingdom Climate Projections 2009 (UKCP09), the fifth generation of climate change information specifically developed for the UK. UKCP09 provides probabilistic projections averaged for administrative regions. Projections that encompasses the Scheme location were sourced for seasonal averages in the 2030s, 2050s and 2080s to assess the lifecycle stages of the Scheme in accordance with Highways England guidance. The spatial boundaries of the assessment for each receptor are defined by the boundaries used within the relevant discipline's environmental chapter.

14.18 Assessment methodology

14.18.1 The climate change assessment has assessed the following receptors during the construction and operational phases:

- Road surfaces, pavements and structures;
- Earthworks, embankments and cuttings;
- Drainage;
- Freshwater quality;

- Flora and fauna;
- Air quality; and
- Road user safety.

14.18.2 In line with the Highways England guidance, the significance of effects of extreme weather and climate change on the Scheme have been assessed based on:

- The likelihood of potential climate impacts (see Table 14.200 for categorisation); and
- The consequence of the impact to scheme receptors (see Table 14.21) for categorisation).

Table 14.20: Likelihood categories

Likelihood category	Description (probability and frequency of occurrence)
Very high	The event occurs multiple times during the lifetime of the project (60 years) e.g. approximately annually, typically 60 events.
High	The event occurs several times during the lifetime of the project (60 years) e.g. approximately once every five years, typically 12 events.
Medium	The event occurs limited times during the lifetime of the project (60 years) e.g. approximately once every 15 years, typically 4 events.
Low	The event occurs once during the lifetime of the project (60 years) e.g. once in 60 years.
Very low	The event may occur once during the lifetime of the project (60 years).
Table notes: Project lifetime is considered to include construction and operational phases. Project lifetime is taken to be 60 years in line with Highways England guidance and WebTAG.	

Table Source: Highways England guidance

Table 14.21: Measure of consequence

Consequence of impact	Description
Very large adverse	National level (or greater) disruption to strategic route(s) lasting more than 1 week.
Large adverse	National level disruption to strategic route(s) lasting more than 1 day but less than 1 week. OR Regional level disruption to strategic route(s) lasting more than 1 week.
Moderate adverse	Regional level disruption to strategic route(s) lasting more than 1 day but less than 1 week.
Minor adverse	Regional level disruption to strategic route(s) lasting less than 1 day.
Negligible	Disruption to an isolated section of a strategic route lasting less than 1 day.

Source: Highways England guidance issued May 2018

14.18.3 The results of the likelihood and consequence are combined to derive a 'significance of effect' classification as outlined in Highways England's guidance.

Table 14.22: Significance matrix

		Measure of likelihood				
		Very low	Low	Medium	High	Very High
Measure of consequence	Negligible	NS	NS	NS	NS	NS
	Minor	NS	NS	NS	S	S
	Moderate	NS	NS	S	S	S
	Large	NS	S	S	S	S
	Very Large	NS	S	S	S	S

Table notes: NS = Not significant, S = Significant

Source: Highways England guidance issued May 2018

14.18.4 The climate vulnerability of the Scheme was assessed, taking other environmental topic's proposed mitigation measures into account; as such it considers the residual risks. The assessment has been informed by best practice approaches, climate guidance and literature as well as professional judgement.

14.19 Assumptions and limitations

14.19.1 There was a partial release of updated climate change in late November 2018 (UKCP18). The UKCP18 project will update the UKCP09 projections over UK land areas and update UKCP09 projections of sea-level rise. Due to their partial release and as Highways England guidance is based on UKCP09 projections, the assessment of the impacts of climate change on the Scheme has been undertaken using climate data from UKCP09.

14.19.2 The UKCP09 climate projections provide information on expected changes to average climate conditions and do not provide information on the expected frequency of extreme events, such as floods or heatwaves. Therefore, additional interpretation is needed to translate UKCP09 into possible changes in extreme events to align with Highways England guidance. Although some information is available in the UK Climate Change Risk Assessments, the interpretation in this report is largely based on professional judgement.

14.19.3 Furthermore, the consequence categories aren't always appropriate for environmental receptors such as water quality. For example, a long-term reduction in the water-quality of the receiving waterbodies will not disrupt the route however, it is an important climate consideration for the Scheme. Therefore, in these cases, professional judgement has been used to categorise these impacts.

14.19.4 The assessment methodology is based on events occurring and the likelihood and consequence of those events on receptors. As this method is not suited to an assessment of operations, road user safety and staff welfare receptors, a qualitative discussion is presented instead.

14.20 Baseline conditions

14.20.1 The following section provides a summary of projected changes in mean temperature and precipitation for the life cycle stages of the project (the 2020s,

2050s and 2080s) under the High emissions scenario for the South East England UKCP09 administrative region. This is the future baseline and forms the basis for the assessment on climate change. This chapter assesses the effects of the future climatic conditions on the Scheme during construction (2020-2022) and during operation (+60 years).

14.20.2 Appendix K.2 Volume 2 provides a summary of current and future changes in climate for the 25 km^2 UKCP09 grid square that encompasses the Scheme location (grid square 1708), for the 2050s under the High emissions scenario (central estimate).

14.20.3 As shown in Table 14.23 below, summers are expected to become hotter and drier and winters are projected to be warmer and drier in the future. Changes increase in magnitude from the 2020s through to 2080s.

Table 14.23: Projected changes in temperature and precipitation for South East England under the High emissions scenario

Climate variable	Time slice and percentile								
	2020s			2050s			2080s		
	10th	50th	90th	10th	50th	90th	10th	50th	90th
Mean winter temperature change (ºC)	0.6	1.4	2.2	1.4	**2.5**	3.8	2.0	**3.7**	5.7
Mean summer temperature change (ºC)	0.5	1.5	2.7	1.4	**3.1**	5.2	2.6	**4.9**	8.1
Mean winter precipitation change (%)	-3	7	20	3	**19**	40	7	**30**	67
Mean summer precipitation change (%)	-24	–4	18	-43	**–19**	9	-57	**–29**	5
Table notes: Changes are relative to a 1961-1990 baseline period.									

Table source: UKCP09

14.20.4 It is important to highlight that there is also likely to be an increase in the frequency and magnitude of extreme events such as heatwaves and heavy rainfall. These are reviewed in more detail in Appendix K.2 in Volume 2, a summary of these is provided here.

14.20.5 Research published by the Met Office Hadley Centre suggests that the European summer heat wave from 2003 could become a normal event by the 2040s[382]. By the 2060s, such a summer would be considered cool according to some climate models. Research has found that it is very likely (confidence level >90%) that human influence has at least doubled the risk of a heat wave exceeding mean summer temperatures experienced in 2003[383].

14.20.6 Wade *et al.,* (2015) presents the results of a project to investigate the development of plausible high-end climate change scenarios (referred to as H++ scenarios) for potential use in the 2017 UK Climate Change Risk Assessment (CCRA) Evidence Report[384]. The H++ scenarios are more extreme climate

[382] Accessed at: https://www.parliament.uk/documents/post/ClimateChangeEventSummary.pdf
[383] Stott, P. A., Stone, D. A. and Allen, M. R. (2004). Human contribution to the European heatwave of 2003, Nature, 432: 610-614
[384] See https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/

change scenarios on the margins or outside of the 10th to 90th percentile range presented in the UKCP09 projections[385]. These provide a high impact, low likelihood event. The H++ scenarios suggest that average summer maximum temperatures will exceed 30°C across most of the UK. Temperatures of the hottest days are likely to exceed 40°C[386]. The H++ scenarios were used in the 2017 UK Climate Change Risk Assessment.

14.20.7 It is expected that as summer rainfall tends to intensify with temperature, the expected increase in atmospheric temperatures may result in more intense summer rainfall events. The H++ scenarios for heavy daily and sub-daily rainfall suggest that, for the same period, there is a 60% to 80% increae in rainfall for summer or winter events based on a consideration of new high-resolution modelling and physical processes[376].

14.20.8 Future projections of storms and high winds are uncertain. The UKCP09 projections depict a wide spread of future changes in mean surface wind speed, however, there is large uncertainty in projected changes in circulation over the UK and natural climate variability contributes much of this uncertainty[387]. Wade *et al,* (2015)[376] recommend that a plausible H++ windstorm scenario is a 50 to 80% increase in the number of windstorms over the UK by 2070-2100 compared to 1975-2005. However, it is important to note that this scenario is based on the CMIP5 climate model simulations, which contain biases in the position of the North Atlantic storm track and systematically under-represents the number of intense cyclonic storms.

14.21 Potential impacts

14.21.1 At Scoping Stage, potential impacts associated with increasing average air temperature in summer and in winter (operational phase only) were scoped in for further assessment (see M2 Junction 5 Environmental Scoping Report (October 2018), Section 14.24.2), as well as the impacts associated with extreme weather events such as increasing frequency and magnitude of heatwaves, droughts and heavy rainfall. However, average precipitation changes were scoped out (see Table 14.24 for details).

14.21.2 Table 14.24 summarises the potential impacts of climate change trends on receptors for the Scheme and details which receptors were scoped out of any further assessment during the scoping stage.

[385] Murphy, J. M., Sexton, D. M. H., Jenkins, G. J., Boorman, P. M., Booth, B. B. B., Brown, C. C., Clark, R. T., Collins, M. G. R., Harris, E. J., Kendon, R. A., Betts, S. J., Brown, T. P., Howard, K. A., Humphrey, M. P., McCarthy, R. E., McDonald, A., Stephens, C., Wallace, R., Warren, R., Wilby, R. Wood. A. (2009) UK Climate Projections Science Report: Climate change projections. Met Office Hadley Centre, Exeter, UK. Crown copyright.
[386] Wade, S., Sanderson, M., Golding, N., Lowe, J., Betts, R., Reynard, N., Kay, A., Stewart, L., Prudhomme, C., Shaffrey, L., Lloyd-Hughes, B., Harvey, B. (2015). Developing H++ climate change scenarios for heat waves, droughts, floods, windstorms and cold snaps. Met Office Hadley Centre, Exeter, UK. Crown copyright.
[387] Brown, S., Boorman, P., McDonald, R., and Murphy. J. (2012) Interpretation for use of surface wind speed projections from the 11-member Met Office Regional Climate Model ensemble. Post-launch technical documentation for UKCP09. Met Office Hadley Centre, Exeter, UK. Crown copyright.

Table 14.24: Climate topics scoped in and out of further assessment

Climate trend	Summary	Scheme phase	Scoped in (✓) / out (×)	Receptors	Potential impacts
Average (air) temperature change					
Warmer winters	Milder winter temperatures are likely to reduce the impact of snow but there is uncertainty around the impacts to operations of 'marginal nights'.	Construction	×	-	• The construction period is in the relatively short-term (2020s) and will only last 18months so should only experience a maximum of two winter periods. Therefore, it is expected that changes will be within the thresholds of the current construction practices. If extreme winter conditions are experienced the consequence would be minor - a delay to programme.
		Operation	✓	Road surfaces, pavements and structures	• Likely to reduce cost and frequency of winter maintenance.
				Nearby freshwater quality	• Reduced transfer of de-icers.
				Road user safety	• Better visibility due to less snowfall. • May be more marginal nights with icy conditions and increased cost of gritting.
Hotter summers	It is expected that changes will be within design thresholds however the location already experiences high summer temperatures so may push temperatures beyond design thresholds.	Construction	✓	Staff welfare	• Staff safety kit and clothing may not be suited to high summer temperatures.
				Nearby freshwater quality	• Reduced network drainage dilution levels due to low water levels. Increased risk of pollution from heavy metal concentrations, oil, grease and toxic chemicals from construction activities.
		Operation	✓	Road surfaces, pavements and structures	• Reduction in service life, additional maintenance work and subsequent user delays.
				Nearby freshwater quality	• Reduced network drainage dilution levels due to low water levels. Increased risk of pollution from heavy metal

Climate trend	Summary	Scheme phase	Scoped in (✓) / out (×)	Receptors	Potential impacts
					concentrations, oil, grease and toxic chemicals from motor vehicles.
				Nearby flora and fauna	• Increased soil moisture deficits and drying. Species may be unable to track climate space (i.e. move to a new location where climate is suitable) and those species able to adapt will become more prominent.
				Air quality	• Reduced air quality.
				Road user safety	• Adverse effect on skid resistance. • Drivers may overheat if traffic is delayed.
				Staff welfare	• Staff safety kit and clothing may not be suited to high summer temperatures. • Increase need for night-time repair works (which are more expensive) when temperatures are lower.
Average precipitation change					
Wetter winters	Changes are expected to be within design thresholds.	Construction	×	-	• The construction period is in the relatively short-term (2020s) and will only last 18months so should only experience a maximum of two winter periods. Therefore, it is expected that changes will be within the thresholds of the current construction practices.
		Operation	×	-	• Changes are expected to be within design thresholds.
Drier summers	Changes are expected to be within design thresholds.	Construction	×	-	• The construction period is in the relatively short-term (2020s) and will only last 18months so should only experience a maximum of two winter periods. Therefore, it is expected that changes will be within the thresholds of the current construction practices.
		Operation	×	-	• Changes are expected to be within design thresholds.

Climate trend	Summary	Scheme phase	Scoped in (✓) / out (✗)	Receptors	Potential impacts
Extreme weather events					
Increased frequency and magnitude of heatwaves	Location already experiences high summer temperatures so may push temperatures beyond design thresholds.	Construction	✓	Nearby freshwater quality	• Reduced network drainage dilution levels due to low water levels. Increased risk of pollution from heavy metal concentrations, oil, grease and toxic chemicals during construction.
				Air quality	• Reduced air quality due to extreme high temperatures could exacerbate the impact of dust and emissions from construction activities.
				Staff welfare	• Staff safety kit and clothing may not be suited to high summer temperatures. There may be a need for night-time construction (which is more expensive) when temperatures are lower.
		Operation	✓	Road surfaces, pavements and structures	• Issues with expansion joints and cracking in concrete pavements and linear features exposed to the atmosphere, such as kerbs. • Issue with distortion of expansion joints, bearings and frame structures from thermal expansion and contraction in bridges. • Reduction in service life, additional maintenance work and subsequent user delays.
				Nearby flora and fauna	• As detailed in 'Hotter summers'.
				Air quality	• As detailed in 'Hotter summers'.
				Operations	• As detailed in 'Hotter summers'.
				Road user safety	• As detailed in 'Hotter summers'.
Increased frequency	Potential impacts on land stability and soil erosion.	Construction	✓	Nearby freshwater quality	• Increased soil and substrate erosion leads to silting and sedimentation of drainage increasing drainage dilution levels.

Climate trend	Summary	Scheme phase	Scoped in (✓) / out (✗)	Receptors	Potential impacts
and magnitude of drought events	Threat to adjacent agricultural land.			Earthworks, embankments and cuttings	• Increased risk of temporary earthworks instability/failures and soil erosion due to soil desiccation.
				Drainage	• Increased soil and substrate erosion leads to silting and sedimentation of drainage causing increased maintenance costs, reduced capacity and risk of flooding.
		Operation	✓	Road surfaces, pavements and structures	• Increased risk of moisture deficit of soils and substrate. • Increased maintenance costs.
				Nearby flora and fauna	• Increased soil moisture deficits and drying. Species may be unable to track climate space and those species able to adapt will become more prominent.
				Nearby freshwater quality	• Increased soil and substrate erosion leads to silting and sedimentation of drainage increasing drainage dilution levels.
				Earthworks, embankments and cuttings	• Increased risk of earth instability and failures due to soil desiccation.
				Road user safety	• Decreased driver safety due to increased sediment debris on the roads from increased soil erosion.
Increased frequency and magnitude of heavy rainfall events	May push drainage beyond design thresholds. Agricultural land is adjacent to the Scheme.	Construction	✓	Nearby freshwater quality	• Increased network run-off which can pick up sediment, oil, grease, heavy metals and toxic chemicals from construction activities.
				Earthworks, embankments and cuttings	• Increased risk of temporary earthworks instability/failures and soil erosion due to increased overland flows and ground saturation.
				Drainage	• Increased soil and substrate erosion from increased overland flows leads to silting and sedimentation of drainage and reduced capacity and risk of flooding.

Climate trend	Summary	Scheme phase	Scoped in (✓) / out (✗)	Receptors	Potential impacts
		Operation	✓	Road surfaces, pavements and structures	• Increased flooding will increase damage to pavements and structures (due to scour). • Additional maintenance to maintain service levels. • Increased operational costs associated with bridge inspections due to increased scour and increased need for pumps due to flooding.
				Nearby freshwater quality	• Increased network run-off which can pick up sediment, oil, grease, heavy metals and toxic chemicals from motor vehicles.
				Earthworks, embankments and cuttings	• Increased risk of earth instability and failures due to increased overland flows and ground saturation.
				Drainage	• Increased soil and substrate erosion from increased overland flows leads to silting and sedimentation of drainage and reduced capacity and risk of flooding.
				Operations / Road user safety	• Increased need for speed reductions, partial and full road closures and the associated need to set up safe diversions. • Reduced driver visibility, unsafe driving conditions and increased risk of aquaplaning.
Increased storms and high wind events	Particularly a concern for the proposed bridge design thresholds and road operations.	Construction	✓	Earthworks, embankments and cuttings	• Increased soil erosion of temporary stockpiles and exposed land during construction. • Increased risk of earth instability and failures due to increased overland flows, ground saturation and high winds.
				Nearby freshwater quality	• Increased transfer of sediment, oil, grease, heavy metals and toxic chemicals, by overland flows and high winds, to the drainage system.
				Drainage	• Increased soil and substrate erosion from increased overland flows leads to silting and sedimentation of drainage and reduced capacity and risk of flooding.

Climate trend	Summary	Scheme phase	Scoped in (✓) / out (×)	Receptors	Potential impacts
		Operation	✓	Road surfaces, pavements and structures	• Increased wind loading on bridges leads to instability and safety risks to road users.
				Road infrastructure	• Increased damage to signs/signals and roadside vegetation as well as accumulation of debris on roads. • Increased maintenance costs.
				Operations / Road user safety	• Increased need for speed reductions, partial and full road closures and the associated need to set up safe diversions from the danger of high winds and damaged road infrastructure/debris on the road.
Increased frequency of 'cold snaps'	Although average winter temperatures are increasing there will still be extreme 'cold snaps'. The freeze-thaw impact of these 'cold snaps' may pose a risk to road surfaces, pavements and structures in addition to road user safety.	Construction	×	-	• The construction period is in the relatively short-term (2020s) and will only last 18months so should only experience a maximum of two winter periods. Therefore, it is expected that changes will be within the thresholds of the current construction practices. If extreme winter conditions are experienced the consequence would be minor – a delay to programme.
		Operation	✓	Road surfaces, pavements and structures	• Issues with freeze-thaw in expansion joints and cracking in concrete pavements and linear features exposed to the atmosphere, such as kerbs. • Reduction in service life, additional maintenance work and subsequent user delays.
				Road user safety	• Decreased driver safety due to ice and snow on roads.

14.22 Design, mitigation and enhancement measures

14.22.1 To understand the vulnerability and resilience of the Scheme design to climate change, information was gathered from the design team and the environmental team on the mitigation measures already built into the design (inherent mitigation).

14.22.2 The climate resilience of this inherent mitigation measures has been considered in the assessment of effects section below. Where additional mitigation is required to reduce the effects further, this is termed further mitigation. Reference has been made to the Highways England Climate Adaption Risk Assessment (2016)[388] .

14.23 Assessment of effects

Significant effects

14.23.1 The likelihood of an impact (post inherent and further mitigation) has been assessed to determine the climate vulnerability of the Scheme. The consequence of the impact, if it occurred, has also been assessed and the significance of the effect is provided in accordance with Table 14.22. The results are presented in Tables 14.25 to Tables 14.35.

[388] Highways England, Climate Adaption Risk Assessment, Progress Update - 2016

Road surfaces, pavements and structures

Table 14.25: Assessment of effects – road surfaces, pavements and structures – operation

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Hotter summers and increased frequency and magnitude of heatwaves	Distortion of joints, bearings and frame structures from thermal expansion and contraction in bridges. This could lead to failure of the bridge.	Inherent mitigation: The Eurocodes used for the 2 bridges in the Scheme stipulate design to a temperature range of -18°C to 34°C which is adjusted to take account of altitude, material type and depth of surfacing thickness, etc. Structures will be monitored throughout the life of the Scheme. Further mitigation: it is recommended that climate change projections are applied to the site temperature record to assess the risk of temperatures exceeding the design thresholds. This analysis should be updated regularly during the life of the asset. Sensitivity tests should be undertaken using the High Emissions 90th percentile projections.	Based on the UKCP09 projections it is unlikely that temperatures will regularly exceed 34°C (the upper temperature of the bridge design standards), but they could do several times during the lifetime of the project. The maximum temperatures observed in the South East of England include Faversham in Kent that recorded 38.5°C in August 2003[389]. In addition, the H++ scenarios suggest that average summer maximum temperatures could exceed 40°C and that the heatwave of 2003 is likely to occur every other year by the 2040s. Following the Highways England guidance and using High Emissions 50th percentile scenario the average maximum temperature in the 2050s is projected as 23.6 °C.	Very Low	A failure of a bridge would lead to national level (or greater) disruption to strategic route(s) lasting more than 1 week.	Very large adverse	Not Significant

[389] See https://www.metoffice.gov.uk/public/weather/climate-extremes/#?tab=climateExtremes

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
			Therefore, this event has been assessed as Very Low likelihood. Under High Emissions 90th percentile it would move into the Low likelihood category.				
	Extreme high temperatures can cause increased rutting and aging of bituminous pavements. Reduction in road service life.	Inherent mitigation: Best practice construction techniques and appropriate material quality standards will be followed to ensure the design lives specified can be met. The design ensures that materials selected are robust enough to endure a range of climate futures. Polymer modified surface course have been selected to ensure rut resistance. Furthermore, heavy-duty macadam will be used in the binder and base course below which has an increased rut resistance. Warm-mix materials permitted subject to departure from standard. The Foundation will comprise of a Class 3 Foundation to resist against rutting.	The mitigation measures reduce the likelihood of extreme temperature impacts on road surfaces. However, there are likely to be minor cracks or potholes during the lifespan of the Scheme therefore this is assessed as Medium likelihood.	Medium	Additional maintenance work and repairs may be needed. This will have an impact on operational costs and cause short-term and localised user delays/disruption whilst work is being undertaken. Therefore, this has been assessed as Negligible consequence.	Negligible	Not Significant

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Increased frequency of extreme temperatures (heat waves and cold snaps)	Freeze-thaw during cold snaps and extreme high temperatures can cause an increase in surface course deterioration, polishing and the formation of potholes. It could also cause cracking of concrete pavements and linear features such as kerbs. Reduction in road service life.	Inherent mitigation: The surface courses have been selected to ensure durability. This includes the adoption of the May 2018 standards for Thin Surface Course including a minimum binder content and water sensitivity requirement above the minimum requirement to promote skid resistance. Hot Rolled Asphalt has been specified for specific sections to promote durability and ensure resilience. Best practice construction techniques have been specified to ensure durability e.g. minimise joints/enhanced bond through integral pavers. Effective drainage will be incorporated. The existing concrete pavement is of continuously reinforced concrete pavement (CRCP) construction and is deemed to be structurally sound. Any widening next to the CRCP has been designed to match like for like construction to ensure compatibility.	As any surface course reaches the end of its life there are likely to be minor cracks or potholes during the lifespan of the Scheme therefore this is assessed as Medium likelihood.	Medium	Additional maintenance work and repairs may be needed. This will have an impact on operational costs and cause short-term and localised user delays/disruption whilst work is being undertaken. Therefore, this has been assessed as Negligible consequence.	Negligible	Not Significant

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Increased frequency and magnitude of drought events	Increased risk of moisture deficit of soils and substrate that could cause road and pavement cracking and distortion.	As above.	As above.	Medium	As above.	Negligible	Not Significant
Increased frequency and magnitude of heavy rainfall events	Increased flooding could increase damage to road surfaces and pavements due to scour.	Inherent mitigation: Surface flooding on the road network will be unlikely because soakaways to collect storm water will be designed to control run-off rates up to the 1 in 100-year return period. The cross fall of the carriageway, grassed drainage channels with suitable outlets, and slot and kerb drains running adjacent to the carriageway will help to ensure that surface water is efficiently removed from the carriageway during heavy rainfall events. Conveyance pipework design will use inflow hyetograph rainfall intensities that include an additional 20% climate change allowance, with a sensitivity test of 40% allowance.	Based on the UKCP09 projections presented in Table 14.4 and Appendix K in Volume 2, it is suggested that these climate change uplifts will reduce the likelihood of flooding. Following the Highways England Guidance, the design to 1 in 100 year rainfall + climate change suggests that the likelihood is 'Very low'. However, H++ scenarios suggest that during rare events we may experience 60-80% more daily winter or summer rainfall.	Very Low	It is assumed that damage to road surfaces (and their repair) will cause regional level disruption to strategic route(s) lasting more than 1 day but less than 1 week.	Moderate adverse	Not Significant

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Increased storms and high wind events	Increased wind loading on bridges leads to instability and safety risks to road users.	Inherent mitigation: The bridges will be designed in compliance with BS EN 1991-1-4 and accompanying NA for the UK. The design will be built to withstand windspeeds of 22m/s. This has been calculated for the M2J5 region. This is then adjusted based on factors such as: altitude; seasonal changes etc. Structures will be monitored throughout the life of the Scheme. Further mitigation: Research suggests that storms may increase over the UK in the future[390]. A storm is defined by the Met Office as a wind event measuring 10 or higher on the Beaufort scale (equivalent to a wind speed of 24.5 m/s. Therefore, it is recommended that the bridge design considers the potential impact of climate change on windspeeds during detailed design.	The Highways England Adaptation Document states that the effect of wind on bridges is minimal as wind is not the dominant load If the detailed design considers the future impact of climate change on wind loads then it is expected that the likelihood of this impact is Very Low.	Very Low	A failure of a bridge would lead to national level (or greater) disruption to strategic route(s) lasting more than 1 week.	Very large adverse	Not Significant

[390] See section 14.20.8.

Table 14.26: Assessment of effects – road infrastructure – operation

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Increased storms and high wind events	Increased damage to signs/signals and roadside vegetation. This can lead to safety risks if broken objects fall onto the road as well as accumulation of debris on roads and resultant accident risks.	Further mitigation: The resilience of road infrastructure, such as signs, to increased risk of storms and high wind events under climate change should be considered at detailed design by comparing the design thresholds for wind loading to those experienced in the observed climate record as well as sensitivity testing against those outlined in section 14.20.8. Also, climate resilient planting methods should be considered for road side vegetation such as appropriate staking of trees to reduce vulnerability to wind damage.	Increased future storms and high wind events could cause widespread damage to signs/signals and roadside vegetation as well as increased accumulation of debris on roads. This is a safety risk to road users.	Medium	It is assumed that this would have a temporary and minor impact causing regional level disruption, lasting less than 1 day. N.B. This will have an impact on the road users as there may be an increased need for speed reductions, partial and full road closures and to set up safe diversions from the danger of high winds and damaged road infrastructure/road debris. This will also have an operational cost impact for repair of damaged road infrastructure.	Minor adverse	Not Significant

Drainage

Table 14.27: Assessment of effects – drainage – construction

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Increased frequency and magnitude of drought events.	Dry and desiccated soils lead to increased soil erosion and could cause sedimentation of drainage reducing their capacity and increasing the risk of flooding.	Inherent mitigation: The drainage strategy specifies that earthworks will have filter drains to collect eroded sediment. Flow attenuation devices will aim to keep the risk of blockage to an acceptable level in line with the sustainable drainage system. Also working practices in line with EA Pollution Prevention Guidelines (which will be included within the CEMP) and soakaways designed to perform good water quality treatment through methods such as physical filtration to remove solids. Stockpile management will be undertaken such as water spraying and timely removal of stockpiled soil to prevent surface water run-off.	These mitigation measures will reduce sedimentation but with increased erosion under climate change it is likely that sedimentation of drainage will still occur. If this causes a reduction in drainage capacity or a blockage this could cause flooding, however it is more likely to be a maintenance issue to keep the drains clean.	Low	Flooding of the road as a result of reduced drainage capacity or a blockage could cause regional level disruption which will take a day for maintenance to clear the blockage. N.B. Increased sedimentation rates are more likely to have an impact on operational costs as checks and maintenance to clear sedimentation may have to be undertaken more frequently.	Minor adverse	Not Significant
Increased heavy rainfall events and Increased storms and high wind events.	Increased soil and substrate erosion from increased overland flows and high winds could lead to silting and sedimentation of drainage and reduced capacity and risk of flooding.			Low		Minor adverse	Not Significant

Table 14.28: Assessment of effects – drainage – operation

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Increased frequency and magnitude of drought events and heavy rainfall events.	Increased soil erosion leads to sedimentation of drainage causing reduced capacity and risk of flooding.	Inherent mitigation: The drainage strategy specifies that earthworks will have filter drains to collect eroded sediment. Flow attenuation devices will aim to keep the risk of blockage to an acceptable level in line with the sustainable drainage system manual.	These mitigation measures will reduce sedimentation but with increased erosion under climate change it is likely that sedimentation of drainage will still occur. If this causes a reduction in drainage capacity or a blockage this could cause flooding, however it is more likely to be a maintenance issue to keep the drains clean.	Low	Flooding of the road as a result of reduced drainage capacity or a blockage could cause regional level disruption which will take a day for maintenance to clear the blockage. N.B. Increased sedimentation rates are more likely to have an impact on operational costs as checks and maintenance to clear sedimentation may have to be undertaken more frequently.	Minor adverse	Not Significant
Increased frequency and magnitude of heavy rainfall events.	Increased risk of water ponding and surface water flooding on the carriageway. This has an impact on driver safety due to the risk of aquaplaning.	Inherent mitigation: The cross fall of the carriageway, grassed drainage channels with suitable outlets, and slot and kerb drains running adjacent to the carriageway will help to ensure that surface water is efficiently removed from the carriageway during heavy rainfall events. Also, surface flooding on the road network will be unlikely because	These mitigation measures will reduce the likelihood of this impact however, it is important that drains are maintained and cleaned regularly to allow water to flow off the road surface efficiently. With the assumption that drains will be properly maintained this is assessed as ‘Low’.	Low	It is likely to cause a regional level disruption to strategic route(s) lasting between 1 day and 1 week whilst the water drains away and depending on the duration of the heavy rainfall event. N.B. this may have an impact on drivers as more speed reductions may be enforced during these conditions.	Moderate adverse	Not Significant

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
		soakaways to collect storm water will be designed to control run-off rates up to the 1 in 100-year return period.					

Earthworks

Table 14.29: Assessment of effects – earthworks, embankments and cuttings – construction

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Increased storms and high wind events	Temporary earthwork failures	Inherent mitigation: The Geotechnical Design Report at detailed design will include ground investigations, stability analyses and design calculations for new and modified earthworks and structures, ensuring their short- and long-term stability. Further mitigation: It is recommended that climate change is considered during these assessments.	This has been assessed as Very Low as it is unlikely to occur during the in the relatively short-term (2020s construction period).	Very Low	It is assumed that this would have a temporary and minor impact to the construction phase with reactionary maintenance works needed. Therefore, this has been assessed as causing regional level disruption, lasting less than 1 day.	Minor adverse	Not Significant

Table 14.30: Assessment of effects – earthworks, embankments and cuttings – operation

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Increased magnitude and frequency of drought events	Increased risk of earthworks, embankment and cutting failure due to soil desiccation.	Inherent mitigation: The Geotechnical Design Report at detailed design will include ground investigations, stability analyses and design calculations for new and modified earthworks and structures, ensuring their short- and long-term stability. Further mitigation: It is recommended that climate change is considered during these assessments.	This has been assessed as Very Low: it could occur during the lifetime of the project (60 years) e.g. once in 60 years.	Very Low	It is assumed that major maintenance works would be needed to fix earthworks failures whilst the Scheme is operational. If the collapsed earthwork fell on the road network this could cause disruption lasting up to 1 week.	Large adverse	Not Significant
Increased frequency and duration of heavy rainfall events	Earthwork, embankment and cutting instability and failures due to increased overland flows and ground saturation.			Very Low		Large adverse	Not Significant

Nearby freshwater quality

Table 14.31: Assessment of effects – nearby freshwater quality– construction

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Warmer winters and hotter summers. Increased frequency and magnitude of	Warmer water temperatures and increased evaporation could reduce the drainage dilution levels increasing the	Inherent mitigation: The Road Drainage and the Water Environment chapter (Chapter 8) identifies potential impacts to groundwater and WFD from construction activities	It is assumed that these mitigation measures are sufficient to account for increasing temperatures and heatwaves in the relatively short-term (2020s construction period).	Very Low	The Road Drainage and the Water Environment chapter (Chapter 8) identifies no Main Rivers or surface water receptors in the study area. There are a number of groundwater	Moderate adverse	Not Significant

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
heatwaves and drought events	risk of pollution to receiving waterbodies.	and proposes mitigation to reduce the likelihood of these impacts. These include adopting good working practices in line with EA Pollution Prevention Guidelines (which will be included within the CEMP) and soakaways designed to perform good water quality treatment through methods such as physical filtration to remove solids. The Soils and Geology chapter (Chapter 10) identifies the need for stockpile management such as water spraying and timely removal of stockpiled soil to prevent sediment transfer from overland flows.			bodies with designated importance in the study area. There are 2 SPZs in the study area however, there will be no discharge to Source Protection Zone (SPZ) 1. There are no statutory designations with water dependency within the study area. Although there is likely to be no disruption to the route from a pollution event or reduced water quality, we have assessed the environmental impact as regionally important lasting between 1 day to a week for the risk posed to designated groundwater bodies.		
	Drier soils are more vulnerable to erosion which could increase sediment loads from site run-off. This could reduce drainage capacity and dilution levels with a resultant impact on water quality.			Very Low		Moderate adverse	Not Significant
Increased frequency and magnitude of heavy rainfall events	Increased network run-off which can pick up sediment, oil, grease, heavy metals and toxic chemicals from construction activities.		It is assumed that these mitigation measures are sufficient to account for increasing heavy rainfall events and storms in the relatively short-term (2020s construction period).	Very Low		Moderate adverse	Not Significant
Increased storms and high wind events	Increased erosion and sediment loads from high wind events and increased rainfall/overland			Very Low		Moderate adverse	Not Significant

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
	flows. Increased risk of pollution and sedimentation of receiving waterbodies.						

Table 14.32: Assessment of effects – nearby freshwater quality – operation

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Warmer winters and hotter summers. Increased frequency and magnitude of heatwaves and drought events	Warmer water temperatures and increased evaporation could reduce drainage dilution levels increasing the risk of pollution to receiving waterbodies.	Inherent mitigation: The Road Drainage and the Water Environment chapter (Chapter 8) identified potential risk of pollution impacts from routine run-off on groundwater during operation but proposes mitigation measures to prevent this. These include pollution control measures installed on all road run-off soakaway drainage to ground. Also, road run-off drainage systems will be designed in accordance with modern toxicity standards derived through application of HAWRAT.	These measures are likely to mitigate the risk of pollution to receiving waterbodies.	Very Low	The Road Drainage and the Water Environment chapter (Chapter 8) identifies no Main Rivers or surface water receptors in the study area. There are a number of groundwater bodies with designated importance in the study area. There are 2 SPZs in the study area however, there will be no discharge to Source Protection Zone (SPZ) 1. There are no statutory designations with water dependency within the study area. Although there is likely to be no disruption to the route from a pollution event or	Moderate adverse	Not Significant
	Drier soils are more vulnerable to erosion which could increase sediment loads from site run-off. This could reduce drainage capacity and			Very Low		Moderate adverse	Not Significant

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
	dilution levels with a resultant impact on water quality. There could also be more accumulation and risk of first flush impacts.	Further mitigation: It is recommended that some consideration of reducing dilution levels in combination with increasing receiving waterbody temperatures under climate change to ensure that the proposed measures will mitigate this increased risk, particularly for the 2050s onwards. For example, heatwaves like that experienced in 2003 could occur every other year by the 2040s.			reduced water quality, we have assessed the environmental impact as regionally important lasting between 1 day to a week for the risk posed to designated groundwater bodies.		
Increased frequency and magnitude of heavy rainfall events	Increased network run-off which can pick up sediment, oil, grease, heavy metals and toxic chemicals from construction activities.			Low	The Road Drainage and Water Environment chapter (Chapter 8) identifies no Main Rivers or surface water receptors in the study area.	Moderate adverse	Not Significant
Increased storms and high wind events	Increased soil erosion from high wind events and increased rainfall/overland flows. Increased risk of pollution and sedimentation of receiving waterbodies.			Low		Moderate adverse	Not Significant

Nearby flora and fauna

Table 14.33: Assessment of effects – nearby flora and fauna – operation

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Hotter summers and increased frequency and magnitude of heatwaves	Increased soil moisture deficits. Species that can adapt will become more prominent.	Further mitigation: Consider climate change in species selection and planting techniques during detailed design of habitat creation and landscaping.	This has been assessed as Low likelihood as species may be adversely affected during the Scheme life.	Low	There is likely to be no disruption to the route, but the ecological benefit of the habitat creation could be lost. Therefore, this could have regional importance and is classified as 'Minor adverse'.	Minor adverse	Not Significant

Air quality

Table 14.34: Assessment of effects – air quality – construction

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Hotter summers, increased frequency and magnitude of heatwaves and drought events	Drier soils may increase the production of dust during construction. This will have negative impacts on air quality.	Inherent mitigation: The Soils and Geology chapter (Chapter 10) identifies the need for stockpile management such as water spraying and timely removal of stockpiled soil to prevent windblown dust.	It is assumed that these mitigation measures are sufficient to account for increasing heatwaves and drought events as well as storms and high wind events in the relatively short-term (2020s construction period).	Very Low	The impacts of soil erosion are likely to be temporary with little disruption to the construction phase.	Negligible	Not Significant
Increased storms and high wind events	Soil erosion of soil stockpiles and exposed	It is also assumed that the duration of soil exposure will be limited, and timely		Very Low		Negligible	Not Significant

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
	land during construction. This will have negative impacts on air quality.	reinstatement of vegetation or hardstanding will be undertaken to prevent soil erosion.					

Table 14.35: Assessment of effects – air quality – operation

Climate trend	Potential impact	Mitigation	Likelihood		Consequence		Significance
			Detail	Category	Detail	Category	
Hotter summers and increased frequency and magnitude of heatwaves	Reduced air quality due to increasing atmospheric temperature.	NA	The air quality modelling uses historic meteorological data to estimate future concentrations. This does not account for the increasing atmospheric temperatures expected with climate change. Therefore, this has been assessed as Low likelihood and could occur during the lifetime of the project (60 years) e.g. once in 60 years.	Low	Although there is likely to be no disruption to the route from an air quality event, we have assessed the environmental impact as regionally important lasting between 1 day to a week for the risk posed to designated groundwater bodies.	Moderate adverse	Not Significant

Operations and staff welfare

14.23.2 The assessment methodology was not suited to operations, road user safety and staff welfare receptors, so a qualitative discussion is presented here.

14.23.3 The scoping study found that although the number of nights with icy conditions may decrease in the future as a result of milder winters, marginal nights may continue to present a risk to road management[391]. Marginal nights are those when the road temperature is close to freezing and may require a judgement call as to whether salting is required. There is a risk to road user safety if gritting is not undertaken and icy conditions do occur. The risk of gritting unnecessarily is to the operational costs. It is recommended that weather forecasting systems are linked to road operational models to help manage this risk.

14.23.4 With increasing summer temperatures and increased frequency and magnitude of heat waves, there are potential risks to staff welfare that need to be considered. This may require a change to staff Personal Protective Equipment (PPE) and safety kit or increased night-time working.

Residual effects

14.23.5 The climate vulnerability assessment has not identified any significant effects of climate change to the Scheme assuming further mitigation measures such as monitoring of structures and consideration of site temperature records are used to properly assess the risk of future climate change.

14.24 Cumulative effects

14.24.1 There are not considered to be any cumulative effects related to climate vulnerability as the assessment is focused on the resilience of the Scheme to climate change. There is no overlap with the resilience of other developments to climate change.

14.25 Monitoring

14.25.1 Monitoring and evaluation of asset (structures, pavements and green infrastructure) resilience to climate change is a key part of the mitigation strategy to inform decision making and the incorporation of any further adaptation measures. Monitoring of the assets within the Scheme will be undertaken as part of the existing highways and bridge inspection programme.

14.26 Summary

14.26.1 This chapter has presented the climate change vulnerability assessment. The assessment has been undertaken in compliance with the Highways England Guidance. The impact of future climatic conditions on the Scheme during construction (2020-2022) and during operation (+60 years) have been considered. The likelihood of a climate change impact (post inherent and further mitigation) has been assessed.

14.26.2 The climate vulnerability assessment has not identified any significant effects of climate change to the Scheme assuming further mitigation measures, such as

[391] Handa, H., Lin, D., Chapman, L., Yao, X. (2006) Robust Solution of Salting Route Optimisation Using Evolutionary Algorithms. IEEE Congress on Evolutionary Computation Sheraton Vancouver Wall Centre Hotel, Vancouver, BC, Canada July 16-21, 2006

monitoring of structures and consideration of site temperature records, are used to properly assess the risk of future climate change.

15. Assessment of Cumulative Effects

15.1 Introduction

15.1.1 This chapter considers the in-combination and cumulative effects of the Scheme. The Environmental Impact Assessment (EIA) Directive and the Infrastructure Planning (EIA) Regulations 2017 (EIA Regulations) require an ES to include the assessment of the inter-relationship between environmental topics and an assessment of cumulative effects with other developments.

15.1.2 This assessment draws upon the guidance provided within the DMRB Volume 11, Section 2, Part 5: 'Assessment and Management of Environmental Effects' and the Planning Inspectorate (PINS) 'Advice Note 17: Cumulative Effects Assessment' (December 2015)[392], which are considered to represent best practice for cumulative effects assessments.

15.1.3 As set out in IEMA Guidance (2011), in-combination (synergistic) and cumulative (additive) effects are defined as:

- Intra-project effects or 'in-combination effects' (synergistic): these effects occur between different environmental topics within the same proposal and as a result of the development's direct effects i.e. combined effects from a single project (the inter-relationship between different environmental factors); and
- Inter-project effects or 'cumulative effects' (additive): these effects occur as a result of the combined action of a number of different projects cumulatively with the project being assessed and on a single resource or receptor i.e. cumulative effects from different projects (with the project being assessed).

15.2 Competent expert evidence

15.2.1 This chapter has been undertaken by Pietro Rescia who is a Chartered Engineer, a Chartered Environmentalist and member of the Society of Environmental Engineers. Pietro has over 25 years of knowledge and experience in ESIA and has used his knowledge and professional judgement to undertake this assessment.

15.3 Assessment methodology

In-combination (synergistic) effects

Study area

15.3.1 The study area for the assessment of in-combination effects of the Scheme reflects the study areas, also termed the spatial Zones of Influence (ZOI), identified within the relevant topic chapters of this ES (Chapters 5 to 14) as set out in Table 15.1.

[392] https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2015/12/Advice-note-17V4.pdf

Table 15.1: Zones of influence

Environmental topic	Zone of influence
Air quality	• For construction 200 m from the construction site and receptors identified within 200m of the affected roads networks; and • For operation 200 m from the Scheme boundary and affected roads, M2, A2 and A249.
Noise and vibration	• For construction effects, 300 m from the construction footprint of the site and roads used by construction traffic; and • For operational effects, 600 m from the carriageway edge of any proposed new routes or existing routes to be bypassed or improved, and 600 m from any other affected routes within 1 km of the proposed new routes or altered existing routes.
Biodiversity[393]	• 30 km for Special Areas of Conservation (SACs) where bats are a qualifying feature; • 5 km for bats; • 2 km for statutory designated sites of nature conservation importance, including European designated sites and nationally designated sites: (SAC, SPA, Ramsar sites ,SSSIs, NNR, LNR); • 2 km for non-statutory LWSs and Roadside Nature Reserves (RNRs); • 1 km for notable habitats, ancient woodland; • 2km for notable or legally protected species and invasive plant species; • 500 m for waterbodies; and • 50 m for veteran trees.
Road drainage and the water environment	• Features of the water environment within 1 km of the Scheme.
Landscape and visual	• 2 km wide corridor around the Scheme, covering the area that the Scheme may influence significantly.
Geology and soils	• Within 500 m of the Scheme boundary.
Cultural heritage	• 200 m for archaeological remains, historic building and historic landscape.
Materials and waste	• The Scheme boundary to cover mineral safeguarding areas, peat resources and the reuse of waste; • The study area for the supply of material assets will be the South East region of England; and • Waste ZOI includes the waste arisings and waste infrastructure capacity within the county of Kent.
Population and human health	• A 500 m buffer from the Scheme boundary; • The ‘best-fit’ of Lower Super Output Areas (LSOAs); • Maidstone 011D (within the North Downs ward); • Swale 008A (within the Hartlip, Newington and Upchurch ward); • Swale 008B (within the Hartlip, Newington and Upchurch ward); • Swale 009A (within the Borden ward); and • Swale 013C (within the West Downs ward).

[393] Due to the relative importance of some nature conservation receptors and the mobility of some species, the desk study and survey areas have been extended for some receptors, based on current best practice guidance (see Section 7.4.3).

Environmental topic	Zone of influence
Climate change	• Climate Change impact is in itself a cumulative effect of all human actions (including development) and therefore deemed not assessable at this inter and intra project scale; and • Due to the inherent cumulative effects of climate change, in-combination effects will be picked up in the environmental topic chapters e.g. Ecology, Road Drainage and the Water environment, Air Quality etc. and are therefore already assessed. For this reason, climate change has been excluded from the cumulative effects assessment to avoid repetition.

Methodology

15.3.2 The methodology for the in-combination effects follows DMRB Volume 11, Section 2, Part 5: Assessment and Management of Environmental Effects.

15.3.3 The assessment methodology for in-combination effects requires the identification of impact interactions associated with the Scheme on key environmental receptors. This ensures that the ES is not a series of separate assessments collated into one document, but rather a comprehensive assessment drawing together all the environmental effects of the proposals.

15.3.4 The effects identified within the technical topic chapters (chapters 5-14) have been assessed to identify potential in-combination effects using professional judgement and a qualitative assessment approach.

15.3.5 The receptors considered in the ES have been sub-divided into the following groups:

- Human – residents, including community and private assets, sensitive receptors and vulnerable groups;
- Human – all travellers i.e. vehicle travellers, cyclists, and pedestrians;
- Ecological receptors – protected species and existing habitats;
- The water environment;
- Heritage assets;
- Geology and soils; and
- Landscape and townscape.

15.3.6 Within these broad groups, individual receptors or groups of receptors that could be affected by the proposals have also been considered. The potential effects acting upon these receptors are primarily changes in traffic, noise, air quality, visual effects, and the physical environment (i.e. water, ecology, heritage). The assessment of residual effects after mitigation has been taken into account. Individual receptors that are affected by two or more residual effects have then been identified and the range of effects likely to impact upon that receptor is described.

15.3.7 Combined effects of Moderate Adverse or Beneficial and above are considered significant in accordance with the methodology applied throughout this ES as described in Chapter 4 (see Section 4.11.5).

Cumulative (additive) effects

Study area

15.3.8 The study area for the identification of 'other development' for inclusion in the assessment of cumulative effects is based upon thresholds and spatial areas. These thresholds and spatial areas have been developed in consultation with Swale Borough Council, professional judgement and taking into account the nature and location of the Scheme and the ZOIs for individual environmental topics.

15.3.9 The thresholds and spatial areas have been defined as follows, recognising that larger, more significant, developments will have wider ranging environmental effects than smaller and more local developments:

- Nationally Significant Infrastructure Projects (NSIPs) – All projects listed on the PINS programme of Projects – within 10 km from the Scheme boundary;
- Regionally Significant Projects – all projects included in the traffic model – 3 km from the Scheme boundary;
- Major development – within and 1.5 km from Scheme boundary; and
- Minor development – within the Scheme boundary.

15.3.10 Nationally significant projects are those that are listed on the PINS Programme of Projects.

15.3.11 The definition of a Regionally Significant Project is a project that has been included within the traffic model and therefore deemed to be of regional significance. This is in line with the traffic model for the Scheme. It is not considered appropriate to align the assessment with the complete scale of the transport model for the Scheme as this includes data from across the whole country, as well as accounting for general growth. Therefore, this assessment utilises selected significant major developments within Maidstone Council and Swale Brough Council, which are reasonably foreseeable.

15.3.12 Major development and minor development have been defined in accordance with Article 2 of the Town and Country Planning Development Management Procedure (England) Order 2015. Thresholds for a major development includes more than 10 new houses, a site area of 0.5 ha and all mineral and waste developments.

15.3.13 For the assessment of cumulative effects, the study area reflects that used in the traffic model, ensuring that the list of 'other developments' align with the 'other development' included in the traffic model.

15.3.14 The assessment of cumulative effects is based on a topic-by-topic identification of where the ZOIs for the Scheme and ZOIs for 'other developments' overlap, and therefore have potential for cumulative effects.

Methodology

15.3.15 To enable a reasonable and proportionate assessment, the following selection criteria have been used to identify and determine 'other development' which

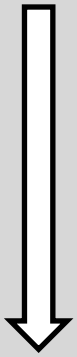
could result in potential cumulative effects with the Scheme:

- Projects on the Infrastructure Planning Commission's (IPC) 1 Programme of Projects;
- Trunk road and motorway projects which have completed the statutory planning processes, including those under construction;
- Other development projects under construction or with valid planning permissions, and for which formal EIA is a requirement or for which non-statutory EIA has been undertaken;
- Applications for consent which have been made, but which have not yet been determined;
- Projects identified in the relevant emerging or adopted Development Plans, with appropriate weight given as they move closer to adoption, recognising that information on these proposals may be limited at present; and
- Projects identified in other plans and programmes which set the framework for future development consents/approvals, where such development is reasonably likely to come forward.

15.3.16 The developments in the above categories will only be considered in the assessment if they are considered to be 'reasonably foreseeable' and 'committed', in line with the guidance in DMRB Volume 11, Section 2, Part 5 HA 205/08.

15.3.17 The 'other developments' identified will then be grouped into tiers. This grouping reflects the likely degree of certainty attached to each development, with Tier 1 being the most certain and Tier 3 being the least certain and most likely to have limited publicly available information to guide the assessment. A description of the tiers is provided in Table 15.2.

Table 15.2: Description of tiers

Tier	Likely degree of certainty	
Tier 1	**a)** Under construction.[394] **b)** Permitted application(s) whether under the Planning Act 2008 or other regimes but not yet implemented. **c)** Submitted application(s) whether under the Planning Act 2008 or other regimes but not yet determined.	Decreasing level of detail likely to be available 
Tier 2	**a)** Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has been submitted.	
Tier 3	**a)** Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has not been submitted. **b)** Identified in the relevant Development Plan (and emerging Development Plans – with appropriate weight being given closer to adoption) recognising that information on any relevant proposals will be limited.	

[394] Where other projects are expected to be completed before construction of the proposed NSIP and the effects of these projects are fully determined, effects arising from them should be considered as part of the baseline and may be considered as part of the construction and operation assessment.

Tier	Likely degree of certainty	
	c) Identified in other plans and programmes (as appropriate) which set the framework for future development consents/approvals where such development is reasonable likely to come forward.	

Table Source: The Planning Inspectorate, Advice note seventeen: Cumulative effects assessment relevant to nationally significant infrastructure projects pg. 6, (2015)

15.3.18 Rather than reporting every interaction, the methodology for the assessment of cumulative effects concentrates on the effects of slight significance or greater, and aims to differentiate between permanent, temporary, direct, indirect and secondary effects, positive or negative.

15.3.19 Where significant cumulative effects, beyond those identified as residual effects from the Scheme in isolation, have been identified, additional mitigation measures should be recommended.

15.3.20 The significance of cumulative effects on each environmental receptor group has then been made based on the balance of scores and using professional judgement.

Traffic related effects

15.3.21 Several environmental topic assessments have a basis of information relating to the road network and quantity of traffic. For the operational phase, the information used is derived from a traffic model. The traffic model used for the Scheme is based on the Lower Thames Area Model (LTAM). This takes in data from across Kent County Council including all major development likely to come forward before, during and after the Scheme has been built.

15.3.22 The topics that make significant use of the traffic model are Air Quality and Noise and Vibration (Chapters 5 and 6 respectively). Certain information from the traffic model will also influence Population and Human Health (Chapter 13), for example, calculations for driver's stress.

15.3.23 For these chapters and assessments, cumulative effects will inherently be assessed using a wider range of development information than more localised effects and assessments.

15.3.24 The Scheme is not expected to have a significant effect on traffic during the construction period. Deliveries will be routed along the M2, M20 and A249. Local roads will not be used as delivery routes. Most construction traffic will come from the north along the M2 or from local quarries which are located around the M20. The number of heavy goods vehicle (HGV) movements to the site during construction will depend on the quantities to be provided. Around 20-50 HGV deliveries to the site are expected each day with 6 HGVs working around the junction for moving plant and material.

15.3.25 The assessment of cumulative effects on construction traffic will be based on the Transport Assessment of construction trip generation data from other developments, if available.

Significance criteria

15.3.26 The assessment of significance of in-combination and cumulative effects has been undertaken in accordance with guidance in DMRB Volume 11, Section 2, Part 5 (HA205/08). The value and magnitude of impact has been determined by the criteria set within the individual topic chapters of this ES and applied to any residual effects. The description of significance also takes into account the capacity of environmental resources and receptors to accommodate any changes that are likely to occur. Consideration has been given to the following:

- The duration of effect i.e. temporary or permanent;
- The extent of effect e.g. the geographical area of an effect;
- The type of effect e.g. whether additive (e.g. loss of two areas of woodland of 1 ha, resulting in 2 ha cumulative woodland loss) or synergistic (e.g. two discharges combine to affect a species which is not affected by a single discharge);
- The frequency of the effect;
- The 'value' and resilience of the receptor affected; and
- The likely success of mitigation.

15.3.27 Table 15.3 provides typical descriptors of effects in determining the significance of effect category for the combined and cumulative effects assessment. Effects that are moderate, large or very large are generally deemed to be significant; slight or neutral effects are not significant.

Table 15.3: In-combination and cumulative effects significance descriptors

Significance category	Typical descriptors of effects resulting from the in-combination or cumulative effects of the Scheme.
Very Large (Adverse or Beneficial)	Effects that the decision-maker must take into account as the receptor/resource is irretrievably compromised. Effects would be: • Permanent and far reaching for receptors of very high value; • Key factor in decision making proves; • Damaging impact for site or feature of international, national or regional importance; and • May include major change in a site or feature of local importance.
Large (Adverse or Beneficial)	Effects that may become key decision-making issue. Effects would be: • Permanent and far reaching for receptors of high value; • Localised for a receptor of very high value; • Temporary for receptor of very high value; and • Very important consideration and material in the decision-making process.
Moderate (Adverse or Beneficial)	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performance. Effects would be: • Permanent and far reaching for receptors of medium value; • Localised for receptors of high value; • Temporary for a receptor of high value; and • May be important but are not likely to be key decision-making factors.

Significance category	Typical descriptors of effects resulting from the in-combination or cumulative effects of the Scheme.
Slight (Adverse or Beneficial)	Effects that are locally significant. Effects would be: • Permanent and far reaching for receptors of low value; • Localised for receptors of medium value; • Temporary for a receptor of medium value; and • Unlikely to be critical in the decision-making process.
Neutral	Where the positive or negative effects of the Scheme or cumulative effects with other development(s) would balance. No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Table Source: Based on Table 2.6 of DMRB Volume 11 Section 2 Part 5 HA 205/08

15.4 Other developments

15.4.1 The final list of 'other developments' was identified and shortlisted through a staged approach in accordance with PINS Advice Note 17.

15.4.2 Stage 1 comprises the identification of the ZOI and a provisional long list of 'other developments'. The long list was compiled through searches of local authority planning webpages for planning application local plans, site allocations, other highway schemes and the PINS project list. In accordance with guidance in DMRB, the relevant Local Planning Authorities (Maidstone Borough Council and Swale Borough Council) were also consulted to determine whether any other developments in the vicinity of the Scheme should be taken into consideration and when they believe these to be likely to come forward. The Stage 1 Long List of 'other developments' is included in Appendix J in Volume 2 presented in a tabular format.

15.4.3 As part of Stage 2 (identify shortlist of 'other developments'), the long list of developments was then reviewed and filtered against the threshold criteria identified in the Methodology section above. The projects shortlisted for further consideration at Stage 2 are indicated in the table in Appendix J in Volume 2 and summarised in Table 15.4 below. The Local Planning Authorities were then consulted on the proposed Stage 2 short list. The locations of the shortlisted developments, in relation to the Scheme and the respective ZOIs that these developments fall into, are shown on Figure 15.1 in Volume 3.

15.4.4 Figure 15.2 in Volume 3 shows the location of each of the 'other developments' in relation to the Scheme and the respective ZOIs that these developments fall into.

15.4.5 The list of proposed developments to be considered in the assessment of cumulative effects is presented in Table 15.4 below. This has been developed with the knowledge and information available at the time of publishing the ES.

15.4.6 Kent County Council is currently preparing the business case to upgrade the Key Street and Grovehurst junctions along the A249, 3.5 km and 7 km east of the Scheme respectively. Both projects are not at the stage of development where construction is likely to overlap with the M2 Junction 5 Scheme and therefore no cumulative effects are expected during the construction phase. Both schemes are also beyond the 3 km distance threshold for regionally significant projects

and in accordance with the methodology, effects are considered to be unlikely and therefore have not been assessed.

Table 15.4: Proposed developments

Development	Distance from site (km)	Application no.	Description
Land at Woodgate Lane	0.1	15/507804/FULL	Removal of existing builders' yard and construction of 11 new dwellings including access road, garaging and car ports (see also 17/506174/NMAMD, 17/503878/SUB, 17/503878/SUB, 17/505068/SUB).
Builders Yard	0.23	18/505147/PNP	Prior Notification for change of use of 3no. buildings and land within their curtilage from Class B8 (storage or distribution) to 3no. Class C3 dwelling/houses. For its prior approval to: Transport and Highways impacts of the development - Contamination risks on the site - Flooding risks on the site - Noise impacts of the development - Impacts of air quality on the intended occupiers of the development - Where the building is located in an area that is important for providing storage or distribution services or industrial services or a mix of those services, whether the introduction of, or an increase in, a residential use of premises in the area would have an adverse impact on the sustainability of the provision of those services.
Land at Wises Lane	2.7	17/505711/HYBRID	Hybrid planning application with outline planning permission (all matters reserved except for access) sought for up to 595 dwellings including affordable housing; a two-form entry primary school with associated outdoor space and vehicle parking; local facilities comprising a Class A1 retail store of up to 480 m^2 GIA and up to 560 m^2 GIA of "flexible use" floorspace that can be used for one or more of the following uses - A1 (retail), A2 (financial and professional services), A3 (restaurants and cafes), D1 (non-residential institutions); a rugby clubhouse / community building of up to 375 m^2 GIA, three standard RFU sports pitches and associated vehicle parking; a link road between Borden Lane and Chestnut Street / A249; allotments; and formal and informal open space incorporating SuDS, new planting / landscaping and ecological enhancement works. Full planning permission is sought for the erection of 80 dwellings including affordable housing, open space, associated access / roads, vehicle parking, associated services,

Development	Distance from site (km)	Application no.	Description
			infrastructure, landscaping and associated SuDS. For clarity - the total number of dwellings proposed across the site is up to 675.
Manor Farm	2.9	17/500727/OUT	Outline application for residential development for up to 50 dwellings with access off Chestnut Street (All others matters reserved), as amended by drawings received 31/05/2017

15.5 Assessment of in-combination effects

15.5.1 The baseline for each environmental topic is described in detail for Air Quality, Noise and Vibration, Biodiversity, Road Drainage and Water Environment, Landscape and Visual, Geology and Soils, Cultural Heritage, Materials and Waste, and Population and Human Health in the preceding chapters (Chapters 5 to 13) of this ES.

15.5.2 Tables 15.5 and 15.6 below describe how the residual effects from each topic specialism may combine to produce in-combination effects during the construction and operational phase respectively. The tables assess the likely significance of in-combination effects for each receptor using the significance descriptors described in Table 15.3. The tables set out the potential residual effects, by topic specialism, for each receptor during the relevant phase of the Scheme. These have been identified within the respective chapters. The final column assesses the likely in-combination effect, should the residual effects interact on a single receptor.

Construction

15.5.3 A slight adverse in-combination effect is expected on residential receptors at Bowl Reed. The in-combination effect is the result of reduced visual amenity and permanent land take assessed within the Landscape and Visual, and Population and Human Health chapters respectively (Chapters 9 and 13 respectively).

15.5.4 This significance is identified due to the highly localised nature of the effect, which is limited to the construction phase. The land take is required to facilitate a safe means of access for residents at Bowl Reed and unlikely to be a critical factor in decision making. No other significant in-combination effects have been identified during construction.

Table 15.5: In-combination effects assessment during construction

Receptor	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human Health	Significance of in-combination effects
Human – residents, including community and private assets, sensitive receptors and vulnerable groups	• Due to the application of the appropriate mitigation measures there is unlikely to be a significant residual effect on air quality due to the construction of the Scheme.	• No significant residual daytime noise effects during construction. • Night-time construction noise may be significant but should be limited to essential works only. • No significant residual vibration effects anticipated.	Not applicable	• No residual effects on surface water and flood risk. • Neutral (not significant) effect on groundwater.	• VP 2: Moderate adverse visual effects at Danaway along Maidstone Road. • VP3: Moderate adverse effects for outdoor employment receptors adjacent to the A249. • VP4: Moderate adverse effects at Milton Bungalow and Bowl Reed along Oad Street, in proximity to the proposed Maidstone Link Road. • VP6: Large adverse visual effects at Whipstakes Farm, Oad Street: Significant • VP8 and VP9: Large adverse effect for employment receptors adjacent to the A249 • VP10 Neutral effect for outdoor employment receptors adjacent to the M2 corridor. • VP11, VP12: Large adverse effect for employment receptors adjacent to the A249 • VP13: large adverse effects for residential receptors adjacent to the A249. • VP14: Moderate adverse effects for residential receptors at Norton Green and slight adverse for outdoor employment receptors here. • VP15: Moderate adverse effects for	• Land contamination: • Minor beneficial effects for residents, commercial and recreational facilities from mitigation against soil/groundwater contaminants • Minor beneficial effects for off-site property (all uses) from mitigation against soil/groundwater contaminants • Slight adverse residual effects from dust to fruit trees at Frognall farm and livestock at Whipstake farm. • 10.3 ha of BMV land will be lost permanently, this is a moderate adverse effect but well below Natural England's 20 ha Threshold of significance • Slight adverse effects at Whipstake farm form the loss of 1.2ha of land.	Not applicable	Not applicable	Private dwellings land take: • The demolition of the Gate House and land take (1012 m^2) from Bowl Reed are both significant adverse effects, however in the context of private dwellings in the core study area the magnitude of impact is predicted to be slight adverse. Change in access: • A permanent access during construction has been agreed at Bowl Reed which is the only permanent slight adverse effect. The other dwellings assessed will likely experience temporary slight adverse effects during construction due to disruption. • The community facilities at Wormdale Hill/Farm and Church Hill will experience slight adverse effects. • Local businesses will experience slight adverse effects due to disruption from construction. • All population receptors will experience slight adverse effects on access to housing and social infrastructure. • All population groups except children and older people will experience slight beneficial effects for access to work and	Slight adverse • Residents at Bowl Reed along Oad Street are likely to experience slight adverse in-combination effects from land take and visual impact through construction of the proposed Maidstone Link Road.

Receptor	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human Health	Significance of in-combination effects
					residential receptors at Hillside Farm and moderate adverse effects for employment receptors at this location. • VP16: Moderate adverse effects at Residential receptors adjacent to the A249: Hinecom, Sandina, Valley View Farm and White House. Moderate adverse effects for receptors fronting onto the A249.				training during construction.	
Human – all travellers, i.e. vehicle travellers, cyclists, and pedestrians	• Due to the application of the appropriate mitigation measures there is unlikely to be a significant residual effect on air quality due to the construction of the Scheme.	Not applicable	Not applicable	• No residual effects on surface water and flood risk. • Neutral (not significant) effect on groundwater.	• VP1: Moderate adverse visual effects for receptors using Wormdale Hill and travelling westerly along the A249 falling to slight during the 18-month phase. • VP2: Moderate adverse visual effects, falling to slight adverse travelling southwest along Maidstone Road towards the M2 J5. • VP3: Large adverse effect for recreational receptors using PRoW KH81. • VP5: slight adverse effect for receptors using the Oad Street overpass falling to slight adverse. • VP6: moderate adverse effect for receptors travelling along Oad Street. • VP7: moderate adverse effect	• Minor adverse effects for NMUs from inhalation of vapours from soil and groundwater.	Not applicable	Not applicable	• Driver stress is predicted to increase temporarily because of construction activity and disruption to traffic. However slower speeds will potentially reduce road traffic accidents. The magnitude of this effect is not considered to be significant. • Slight adverse effects for NMUs with respect to Amenity and severance. • NMU receptors on Pett Road, Oad Street, Maidstone Road and at bus stops also experiencing slight adverse effects for journey lengths.	Neutral

Receptor	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human Health	Significance of in-combination effects
					receptors on PRoW ZR70. • VP8 and VP9: moderate adverse effect for receptors on PRoW KH85. • VP10 slight adverse effect for recreational receptors using PRoW ZR135. • VP11: Large adverse effect for receptors on PRoW KH85. • VP12: Large adverse effect for receptors on PRoW ZR71. • VP13: Moderate adverse effect for receptors travelling along the A249. • VP14: moderate adverse effects for receptors using PRoW KH80. • VP15: moderate adverse effects for receptors using PRoW KH80. • VP16: moderate adverse effects for transport receptors along the A249.					
Ecological receptors – protected species and existing habitats	• Due to the application of the appropriate mitigation measures there is unlikely to be a significant residual effect from air quality due to the construction of the Scheme.	Not applicable	• Slight adverse residual effects due to the loss of calceous grassland and the translocation of habitats. At Honeycrock Hill (MA04), Church Hill and Stockbury (MA11). • There will be temporary slight adverse effects from the area loss of habitats (woodland hedgerows and	• No residual effect on surface water, flood risk and WFD. • Neutral (not significant) effect on groundwater.	Not applicable	• No significant residual effects with regards to land contamination and geomorphology and ground stability are expected during construction of the Scheme.	Not applicable	Not applicable	Not applicable	Neutral

Receptor	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human Health	Significance of in-combination effects
			ponds) and moderate adverse effects for dormice habitats. • There will be an increase in the total area and quality of habitats over the long-term but this will take time to develop. There will be a slight positive residual effect on the conservation status of these habitats.							
The water environment	Not applicable	Not applicable	Not applicable	• No residual effect on surface water, flood risk and WFD. • Neutral (not significant) effect on groundwater.	Not applicable	• No significant residual effects with regards to land contamination and geomorphology and ground stability are expected during construction of the Scheme.	Not applicable	Not applicable	Not applicable	Neutral
Heritage assets	Not applicable	Not applicable	Not applicable	• No residual effect on surface water or flood risk. • Neutral (not significant) effect on groundwater.	• VP3: Due to existing screening vegetation and the nature of topography no significant effects are anticipated at St Mary Magdalene Church and ringwork and baileys scheduled monument. A woodland belt provides screening along the field boundary adjacent to Church Hill.	• No heritage assets were identified as potential receptors of land contamination and geomorphology and ground stability during construction of the Scheme.	• Moderate adverse on ATK1 and ATK3. • Unknown direct physical effects on unknown buried remains. • Slight adverse on historic landscape and setting.	Not applicable	Not applicable	Neutral
Geology and soils	Not applicable	Not applicable	Not applicable	• No residual effect on surface water or flood risk. • Neutral (not significant) effect on groundwater.	Not applicable	• Minor adverse changes in physical properties and ground stability through soil erosion, collapsible ground, shrinking or swelling of clay and dissolution as well as a minor adverse risk of UXO. • Minor/moderate beneficial effects by	Not applicable	Not applicable	Not applicable	Neutral

Receptor	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human Health	Significance of in-combination effects
						reducing to risk of landslides and running sands. No significant residual effects with regards to land contamination and geomorphology and ground stability are expected during construction of the Scheme. • 10.3 ha of BMV land will be lost permanently, this is well below Natural England's 20 ha threshold of significance.				
Landscape and townscape	Not applicable	Not applicable	Not applicable	• No residual effect on surface water or flood risk.	• Moderate adverse effects at Regional LCA: LAK Bicknor: Mid Kent Downs; LCA: LAK Chatham Outskirts: Mid Kent Downs; Local LCA; MBC Hucking Dry Valleys and SBC: Newington Arable Farmlands • Slight adverse effects at Regional LCA: LAK Fruit Belt; Local LCA: MBC: Bredhurst and Stockbury Downs; SBC Borden Mixed farmlands and Deans Bottom.	• No significant residual effects with regards to land contamination. • Minor adverse effects on the aesthetics of the topography to agricultural holdings. • 10.3 ha of BMV land will be lost permanently, this is well below Natural England's 20 ha threshold of significance. • Slight adverse effects from the loss of 0.9 ha of a grass field between the A269 and Maidstone Road.	Not applicable	Not applicable	Not applicable	Neutral

Operation

15.5.5 Table 15.6 below sets out the in-combination effects, by topic specialism, for each receptor during the operational phase of the Scheme and details how this may change from Opening Year (1) to Design Year (15). No significant in-combination effects are anticipated during the operational phase of the Scheme and the overall significance is assessed as being neutral.

Table 15.6: In-combination effects assessment during operation

Receptor	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human health	Significance of in-combination effects
Human – residents, including community and private assets, sensitive receptors and vulnerable groups	• In accordance with IAN 174/13 the Scheme is not expected to exceed the annual mean NO_2 air quality objective hence the Scheme is not expected to have a significant effect.	• Properties along Maidstone Road will experience a negligible increase in noise, up to 1 dB at one property although this increase is not considered significant. • Properties in the Stockbury Valley postcode ME9 7QD and receptors NIA 4574 and NIA 4575 will experience significant beneficial effects upon operation of the Scheme from noise level decreases by more than 4 dB.	Not applicable	• No residual effects on surface water and flood risk. • No residual impacts to flood risk are anticipated. Vale Cottages are adjacent to an area of surface water flooding (1 in 100 probability). The impact of flooding is minor and not inside the property therefore, the effect is not significant. • Neutral (not significant) effect on groundwater. • The WFD assessment (Appendix E.3 in Volume 2) shows no residual impacts subject to correct implementation of all mitigation measures.	• VP2: Slight adverse effects for residential receptors along the Maidstone Road at Danaway • VP4: Moderate adverse effects in Opening Year 1 reducing to slight adverse in Design Year 15. Adverse effects for residential receptors: Milton Bungalow and Bowl Reed along Oad Street, in proximity to the proposed Maidstone Link Road. • VP6: Moderate adverse effects for residential receptor: Whipstakes Farm, Oad Street. • VP8 and VP9: Slight adverse effects for outdoor employment receptors adjacent to the A249. • VP11: Slight adverse effects for outdoor employment receptors adjacent to the A249. • VP12: Slight adverse effects for outdoor employment receptors	Land contamination: • Minor beneficial effects for residents, commercial and recreational facilities from mitigation against soil/groundwater contaminants • No significant residual impacts with regards to land contamination and geomorphology and ground stability are expected upon operation of the Scheme. • 10.3 ha of BMV land will be lost permanently, this is well below Natural England's 20 ha threshold of significance. • Slight adverse effects at Whipstake Farm from the loss of 1.2 ha of land.	Not applicable	Not applicable	• Minor beneficial effects for private properties through improved capacity and accessibility. However, Stockbury and the southern part of Maidstone Road will experience slight adverse effects. • All population groups will experience slight beneficial effects from greater access to housing and social infrastructure. • All population groups except children and older groups will experience slight beneficial effects from greater access to work and training.	Neutral • (In both Opening Year 1 and Design Year 15)

Receptor	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human health	Significance of in-combination effects
					adjacent to the A249. • VP13: Moderate adverse effects for outdoor employment receptors adjacent to the A249. • VP14: Slight adverse effects for residential receptors at Norton Green. • VP15: Slight adverse effects for residential receptors at Hillside Farm. • VP16: Slight adverse effects for outdoor employment receptors fronting onto the A249.					
Human – all travellers, i.e. vehicle travellers, cyclists, and pedestrians	• In accordance with IAN 174/13 the Scheme is not expected to exceed the annual mean NO_2 air quality objective hence the Scheme is not expected to have a significant effect.	Not applicable	Not applicable	• No residual effects on surface water and flood risk. • No residual impacts to flood risk are anticipated. • Neutral (not significant) effect on groundwater. • The WFD assessment (Appendix E.3 in Volume 2) shows no residual impacts subject to correct implementation of all mitigation measures.	• VP3: Slight adverse effects for recreational receptors using KH81. • VP5, VP6: Slight adverse effects for transport receptors using the Oad Street overpass. • VP8 and VP9: Slight adverse effects for receptors on PRoW KH85. • VP10: Slight adverse effects for recreational receptor: PRoW ZR135. • VP11: Slight adverse effects for recreational receptors on PRoW KH85.	Land contamination: • Minor beneficial effects for NMUs from mitigation against soil/groundwater contaminants. • No significant residual effects with regards to land contamination and geomorphology and ground stability are expected upon operation of the Scheme.	Not applicable	Not applicable	• During operation, significant beneficial effects are likely for NMU following the closure of Honeycrock Hill to vehicles and creation of new PRoW facilities, linking the Church Hill junction to the north and the A249 roundabout to the east • PRoW footpath ZR71 and ZR85 will experience slight beneficial effects from improved journey length and journey times.	Neutral • (In both Opening Year 1 and Design Year 15)

Receptor	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human health	Significance of in-combination effects
					• VP12: Slight adverse effects for recreational receptor: PRoW ZR71. • VP13: Slight adverse effects for transport receptors travelling along the A249. • VP14, VP15: Slight adverse effects for recreational receptor: PRoW KH80. • VP16: Slight adverse effects for transport receptors travelling along the A249.					
Ecological receptors – protected species and existing habitats	• NOx concentrations at Wouldham to Detling Escarpment SSSI/ North Downs Woodlands SAC are expected to increase due to increased traffic flows. Change in nitrogen deposition is expected to be less than 0.1 kg/N/ha/year which is unlikely to be a significant residual effect.	Not applicable	• The Scheme is likely to have long-term slight positive effects on habitats, dormice, and breeding birds. • No adverse residual impacts are anticipated during operation of the Scheme.	• No residual effect on surface water, flood risk and WFD. • Neutral (not significant) effect from groundwater pollution.	Not assessed	Land contamination: • Minor beneficial effects for Ancient Woodland from mitigation against soil/groundwater contaminants. No significant residual effects with regards to geomorphology and ground stability are expected upon operation of the Scheme.	Not applicable	Not applicable	Not assessed	Neutral • (In both Opening Year 1 and Design Year 15)
The water environment	Not applicable	Not applicable	Not applicable	• No residual effect on surface water, flood risk and WFD. • Neutral (not significant) effect from groundwater pollution.	Not applicable	Land contamination: • Minor beneficial effects for Controlled Waters on and off-site from mitigation against	Not applicable	Not applicable	Not applicable	Neutral • (In both Opening Year 1 and Design Year 15)

Receptor	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human health	Significance of in-combination effects
						soil/groundwater contaminants.				
Heritage assets	Not applicable	Not applicable	Not applicable	• No residual effect on surface water or flood risk. • Neutral (not significant) effect on groundwater.	Not applicable	• No heritage assets were identified as potential receptors of land contamination and geomorphology and ground stability upon operation of the Scheme.	• Slight adverse effects on setting.	Not applicable	Not applicable	Neutral • (In both Opening Year 1 and Design Year 15)
Geology and soils	Not applicable	Not applicable	Not applicable	• No residual effect on surface water or flood risk. • Neutral (not significant) effect on groundwater.	Not applicable	• No significant residual impacts with regards to land contamination and geomorphology and ground stability are expected upon operation of the Scheme. • 10.3 ha of BMV land will be lost permanently, this is well below Natural England's 20 ha threshold of significance.	Not applicable	Not applicable	Not applicable	Neutral • (In both Opening Year 1 and Design Year 15)
Landscape and townscape	Not applicable	Not applicable	Not applicable	• No residual effect on surface water or flood risk.	• Slight adverse effects to LAK Bicknor and Chatham Outskirts: Mid Kent Downs; MBC Hucking Dry Valley; SBC Newignton Arable farmlands, Deans Bottom and Tunstall farmlands.	• 10.3 ha of BMV land will be lost permanently, this is well below Natural England's 20 ha threshold of significance. • Slight adverse effects from the loss of 0.9 ha of a grass field between the A269 and Maidstone Road.	Not applicable	Not applicable	Not applicable	Neutral • (In both Opening Year 1 and Design Year 15)

15.6 Assessment of cumulative effects

15.6.1 Tables 15.7 and 15.8 below set out the potential cumulative effects, by topic specialism for each of the shortlisted developments and by Scheme phase. Only those developments that have been shortlisted have been assessed here. Stage 1 and 2 of this assessment eliminated developments that were not deemed to have potential for cumulative effects to arise due to scale, geographical location and any temporal overlap in construction phases. The long list of developments can be found in Appendix J in Volume 2.

15.6.2 The below assessments in Tables 15.7 to 15.8 represent Stages 3 and 4 of the assessment of cumulative effects. Due to the size of the tables, these have been split into construction and operational phases. The assessment regards any residual effects noted in the relevant topic sub-sections.

Construction

15.6.3 Cumulatively it is possible that the M2 Junction 5 Scheme and Land at Woodgate Lane development could have a significant adverse noise effect on the Shortlands receptor if the construction schedules of both schemes overlap. The effects of daytime construction noise from the M2 Junction 5 Scheme is below significant noise threshold BS5228, although it is likely to be surpassed should the construction activity overlap with the Woodgate Lane development.

15.6.4 No further potential significant cumulative effects were identified during the construction phase and the overall significance of effects was assessed as being neutral. However, information regarding construction schedules was not available for the ‘Land at Wises Lane’ and ‘Manor Farm’ developments. Should the construction schedules overlap between these developments and the Scheme, there is a potential for significant cumulative effects arising from construction traffic along the A249. This could potentially result in visual disturbance and disruption to the tranquillity of a sensitive landscape. Due to the lack of available information on these developments, this effect has not been included as part of the likely effects. This is in line with PINS Advice Note 17[395].

15.6.5 Potentially significant effects on soil contamination, dust and air pollution from construction will be mitigated through the relevant regulations and are not considered significant.

[395] Paragraph 3/4/2 which states “assessment should be undertaken to an appropriate level of detail, commensurate with the information available at the time of assessment. Information on some proposals may be limited and such gaps should be acknowledged within the assessment”

Table 15.7: Cumulative effects assessment during construction

Development	Distance from Scheme	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human Health	Significance of cumulative effects
Land at Woodgate Lane	0.10	Potential for overlapping effects during construction at nearby receptors. Provided appropriate mitigation measures are applied, there should not be any significant adverse effect. • Neutral	There is potential for a cumulative construction effect as a significant effect was predicted at Shortlands during the construction phase of the Scheme. • Potential significant cumulative effects at Shortlands	The loss of habitats potentially capable of supporting reptiles and breeding birds will be offset by a planting strategy proposed as part of this development. • Negligible adverse cumulative effects	Drainage systems should accommodate their own temporary drainage requirements during the construction phases and appropriate mitigation that should ensure minimal impacts to water through construction and operational phases. It is therefore concluded that there would be no significant adverse cumulative effects during construction or operation. • Neutral	No degree of cumulative inter-visibility between the proposed developments and the proposed scheme. • No significant cumulative effects	The development could potentially affect surface water, without implementation of design and mitigation measures. It is likely that mitigation will have been required to ensure that the planned development is suitable for its intended use and mitigation and control measures will be adopted during the construction phase to reduce its impacts to the environment. Therefore, a low potential for cumulative impacts is predicted during the construction phase. • Neutral	No cumulative effects on designated, non-designated heritage assets and archaeological remains are predicted. • Neutral	There was no data contained in the application for material assets. However, there will be a quantity of construction materials used in development, which will have a cumulative effect on material assets. The M2 Junction 5 scheme alone will have a significant effect on Kent's baseline waste infrastructure capacity. This development will produce an estimated 429 tonnes of CD&E; increasing the effect of M2 Junction 5 by 0.003% which is below perceptible levels of measurement. • Neutral	• Neutral	• Neutral
Builders Yard	0.23	Potential for overlapping effects during construction at nearby receptors. Provided appropriate mitigation measures are applied, there should not be any significant adverse effect. • Neutral	No cumulative construction effects are expected as the schemes are sufficiently far apart. • Neutral	Ecological impact was not assessed in the application and is therefore unknown, particularly for bats. Given that the M2 Junction 5 scheme will have negligible adverse effect on bats and there is little connecting habitat between these schemes, no significant effects are expected. • Neutral	Drainage strategies should be in place or proposed for this development. These separate drainage systems should accommodate their own temporary drainage requirements during the construction phases and appropriate mitigation that should ensure minimal impacts to	If the construction phases of both schemes overlap, there may be slight adverse effects from construction traffic along Maidstone Road; however, given the scale of development, they are unlikely to be significant. • Neutral	The development could potentially affect surface water without implementation of design and mitigation measures. It is likely that mitigation will have been required to ensure that the planned development is suitable for its intended use and mitigation and control measures will be adopted during the	No cumulative effects on designated, non-designated heritage assets and archaeological remains are predicted. • Neutral	There was no data contained in the application for material assets. However, there will be a quantity of construction materials used in development which will have a cumulative effect on material assets. There was no data contained in the application for waste. Given the scale of the application (3 residential units)	The cumulative effects of air pollution, construction traffic and dust will be of limited duration, intensity and affect a low number of people. Appropriate mitigation measures and suitability will have to be demonstrated in the planning application and therefore the effects will be negligible.	• Neutral

Development	Distance from Scheme	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human Health	Significance of cumulative effects
					water through construction and operational phases. It is therefore concluded that there would be no significant adverse cumulative effects during construction or operation. • Neutral		construction phase to reduce its impacts to the environment. Therefore, a low potential for cumulative impacts is predicted during the construction phase. • Neutral		the waste generated is unlikely to have a significant cumulative effect with waste generated from M2 Junction 5 scheme. • Neutral	• Neutral	
Land at Wises Lane	2.70	Not likely to be affected from dust emissions during construction as it is not within 200 m of the construction site. • Neutral	No cumulative construction effects are likely as the schemes are sufficiently far apart. • Neutral	Given the distance of these developments in excess of 2 km from the Scheme, they are outside of the EZoI for all species associated with the Scheme and are therefore unlikely to contribute to significant cumulative effects. • Neutral	Beyond boundary of assessment.	If the construction phases of both schemes overlap, there may be moderate adverse effects from construction vehicles travelling along the A249 and the local roads. These effects combined would lead to a loss of tranquillity and visual disturbance. Given the scale of development these effects may be significant, however there is insufficient construction data available to inform this assessment. • Potential moderate adverse cumulative effects	Outside of the study area.	No cumulative effects on designated, non-designated heritage assets and archaeological remains are predicted. • Neutral	There was no data contained in the application for material assets. However, there will be a quantity of construction materials used in development which will have a cumulative effect on material assets. This development will produce an estimated 6656 tonnes of CD&E waste which equates to a 0.05% increase in waste generation. The M2 Junction 5 scheme, in isolation, will have a significant effect on Kent's baseline waste generation capacity. The cumulative effects do not become significant. • Neutral	• Neutral	Significant cumulative effects could arise from construction traffic for the schemes if their construction phases were to overlap. These effects cannot be qualified without the relevant construction schedule and traffic data. Any disruption should be confined to the construction period and hours of operation. Moreover, vehicle movements will occur intermittently and any disruption should be short-lived. Control measures to mitigate the cumulative effects will be identified within the Construction Environmental Management Plan, which will be developed during the detailed design stage once more construction data will be available. • Neutral

Development	Distance from Scheme	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human Health	Significance of cumulative effects
Manor Farm	2.90	Not likely to be affected from dust emissions during construction as it is not within 200 m of the construction site. • Neutral	No cumulative construction effects are likely as the Schemes are sufficiently far apart. • Neutral	These developments are beyond the 2 km from the Scheme, they are outside of the EZoI for all species associated with the Scheme and are therefore unlikely to contribute to significant cumulative effects. • Neutral	Beyond boundary of assessment.	If the construction phases of both schemes overlap, there may be moderate adverse effects from construction vehicles travelling along the A249 and the local roads. These effects combined would lead to a loss of tranquillity and visual disturbance. Given the scale of development these effects may be significant, however there is insufficient construction data available to inform this assessment. • Potential moderate adverse cumulative effects	Outside of the study area.	No cumulative effects on designated, non-designated heritage assets and archaeological remains are predicted. • Neutral	The development will have an effect on material asset use. No waste or material data was recorded in this application. The M2 Junction 5 scheme will have a significant effect on Kent's baseline waste generation capacity individually. The cumulative effects from both of these schemes will therefore not become significant. • Neutral	• Neutral	Significant cumulative effects could arise from construction traffic for the schemes if their construction phases were to overlap. These effects cannot be qualified without the relevant construction schedule and traffic data. Any disruption should be confined to the construction period and hours of operation. Moreover, vehicle movements will occur intermittently and any disruption should be short-lived. Control measures to mitigate the cumulative effects will be identified by the Construction Environmental Management Plan, which will be developed during the detailed design stage once more construction data will be available. • Neutral

Operation

15.6.6 Table 15.8 below sets out the cumulative effects, by topic specialism for each of the shortlisted developments in the operational phase and details how this may change from Opening Year (1) to Design Year (15). The overall significance of cumulative effects has been assessed as being slight adverse in Opening Year (1) and neutral by Design Year (15).

15.6.7 An overall slight adverse cumulative effect was identified in the Opening Year (1) between the M2 Junction 5 Scheme and Land at Wises Lane development. The Landscape and Visual chapter (Chapter 9) identifies moderate adverse effects due to erosion of the rural landscape. However, a planting strategy is proposed as part of the Wises Lane development, which will provide mitigation by Design Year 15 once the planting has matured. The Population and Human Health chapter (Chapter 13) identifies slight positive effects from the provision of additional housing and community infrastructure. The resultant, overall cumulative effect has been assessed as being slight adverse and is expected to reduce to neutral by Design Year 15 once the mitigation planting has matured.

15.6.8 A similar cumulative effect was identified between the M2 Junction 5 Scheme and Manor Farm development which is a smaller proposal adjacent to the Land at Wises Lane site. Due to the small scale of development the cumulative effect was assessed as being neutral.

15.6.9 Potential cumulative effects for geology and soils were mitigated through legislation and best practice guidance.

15.6.10 No significant cumulative effects were identified for air quality, noise and vibration and road drainage and the water environment.

15.6.11 The cumulative effects for materials and waste could not be assessed due to a lack of available and relevant information on the developments.

Table 15.8: Cumulative effects assessment during operation

Development	Distance from Scheme (km)	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human Health	Significance of cumulative effects
Land at Woodgate Lane	0.1	Unlikely to be any significant adverse effect at nearby receptors. • Neutral	The proposed development would not affect traffic flows, so no operational phase cumulative effects would occur. • Neutral	• Neutral	The magnitude and significance for both has been assessed as negligible with neutral/insignificant effects. This is on the assumption drainage strategies should be in place or proposed for these developments. The separate drainage systems should accommodate their own temporary drainage requirements during the construction phases and appropriate mitigation should ensure minimal impacts to water through construction and operational phases. It is therefore concluded that there would be no significant adverse cumulative effects during construction or operation. • Neutral	• Neutral	Developments will be operated in accordance with granted consents and the relevant regulation and best practice guidance in applying Best Available Techniques and pollution prevention, therefore, a low potential for cumulative impacts is predicted during operation. • Neutral	No cumulative effects on non-designated heritage assets and archaeological remains are predicted. • Neutral	The effect on materials assets and waste during the operational phase is not assessed.	• Neutral	Neutral • (In both opening year 1 and Design Year 15)
Builders Yard	0.23	Unlikely to be any significant adverse effect at nearby receptors. • Neutral	The proposed development would not affect traffic flows in the study area, so no operational phase cumulative effects would occur. • Neutral	There is little connecting habitat between the two schemes. Therefore, cumulative effects are unlikely. • Neutral	The magnitude and significance for both has been assessed as negligible with neutral/insignificant effects. This is on the assumption drainage strategies should be in place or	• Neutral	Developments will be operated in accordance with granted consents and the relevant regulation and best practice guidance in applying Best Available Techniques and	No cumulative effects on designated, non-designated heritage assets and archaeological remains are predicted. • Neutral	Material effects cannot be qualified without the relevant data.	• Neutral	• Neutral

Development	Distance from Scheme (km)	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human Health	Significance of cumulative effects
					proposed for these developments. The separate drainage systems should accommodate their own temporary drainage requirements during the construction phases and appropriate mitigation should ensure minimal impacts to water through construction and operational phases. It is therefore concluded that there would be no significant adverse cumulative effects during construction or operation. • Neutral		pollution prevention, therefore, a low potential for cumulative impacts is predicted during operation. • Neutral				
Land at Wises Lane	2.7	Unlikely to be any significant adverse effect at nearby receptors.	No significant effects are expected in the operational phase due to the Scheme.	This development is outside of the EZoI for all species associated with the Scheme and are therefore unlikely to contribute to significant cumulative effects. • Neutral	Beyond boundary of assessment.	The proposed development would further extend the urban edge of Sittingbourne, eroding the rural landscape. This in conjunction with the M2 Junction 5 scheme introducing urbanising features, would lead to significant cumulative effects, particularly on the regional landscape. A planting strategy is proposed as mitigation and will reduce effects below significant	Outside of the study area	No cumulative effects on designated, non-designated heritage assets and archaeological remains are predicted. • Neutral	There may be significant quantities of waste produced by this development, which will produce a cumulative impact which cannot be qualified without the relevant waste figures. Material effects cannot be qualified without the relevant data.	Minor beneficial effects for the health and social wellbeing of the community via the provision of much needed housing and community infrastructure in a core and wider area where there are known to be barriers to housing and deprivation in the living environment. Effects will be slightly beneficial but not significant. • Slight Positive	The provision of housing and community infrastructure will have slight localised benefits over a sustained period for the community. That said, this may be offset by the adverse landscape effects that development will have on the regional landscape. A planting strategy is proposed as mitigation and will reduce the effects below significant

Development	Distance from Scheme (km)	Air Quality	Noise and Vibration	Biodiversity	Road Drainage and Water Environment	Landscape and Visual	Geology and Soils	Cultural Heritage	Materials and Waste	Population and Human Health	Significance of cumulative effects
						thresholds by Design Year 15. • Opening Year: Moderate adverse effects. • Design Year 15: Slight adverse.					levels by Design Year 15. • Opening Year: Slight Adverse • Design Year 15: Neutral
Manor Farm	2.9	Unlikely to be any significant adverse effect at nearby receptors. • Neutral	No significant effects are expected in the operational phase due to the Scheme. • Neutral	This outside of the EZoI for all species associated with the Scheme and are therefore unlikely to contribute to significant cumulative effects. • Neutral	Beyond boundary of assessment.	The proposed development would further extend the urban edge of Sittingbourne and lead to erosion of the landscape. The Manor Farm development is smaller than the Land at Wises Lane scheme and the adverse landscape effects are not considered significant. • Slight adverse	Outside of the study area	No cumulative effects on designated, non-designated heritage assets and archaeological remains are predicted. • Neutral	Material effects cannot be qualified without the relevant data.	Slight beneficial effects for the health and social wellbeing of the community via the provision of much needed housing and community infrastructure in a core and wider area where there are known to be barriers to housing and deprivation in the living environment. Effects will be slightly beneficial but not significant. • Slight positive	The provision of housing and community infrastructure will have slight localised benefits over a sustained period for the community however, this is counteracted by a slight adverse landscape effect arising from erosion of the regional landscape. The resultant cumulative effect is not considered significant. • Neutral (In both Opening Year 1 and Design Year 15)

15.7 Mitigation measures

15.7.1 No additional mitigation measures beyond those already identified are proposed, as no overall significant cumulative or in-combination effects have been identified.

15.7.2 Due to the uncertain and unknown elements regarding the impacts of other developments and their construction programmes, specific measures have not been identified at this stage but may be required, such as agreeing a staggered construction between developments close to the Shortlands noise receptor. Discussions with developers, contractors and the relevant local planning authorities may be held at a later stage to determine opportunities for enhancement of additional mitigation measures.

15.8 Residual Effects

15.8.1 With the mitigation measures in place, there will be no significant residual adverse effects during the construction and operational phases.

15.9 Assumptions and limitations

15.9.1 This assessment has been undertaken using professional judgement and is based on information which is currently available and identified through consultation with the Local Planning Authorities. It is possible that there will be future planning applications for developments which could result in cumulative effects with the Scheme but, in line with the guidance in DMRB Volume 11, Section 2, Part 5 HA 205/08, only those developments which are 'reasonably foreseeable' and 'committed' have been included in the assessment.

15.9.2 Construction traffic and traffic effects during construction have not been cumulatively assessed as the Scheme has not been subject to a traffic assessment.

15.9.3 Cumulative impacts caused by multiple concurrent developments on the same receptors have been evaluated solely on the basis of professional judgement.

15.9.4 For both the in-combination and cumulative effects assessments, a cautious approach has been used. For in-combination effects this assumes that effects arising from two different topics on one receptor will occur concurrently, unless timing is explicitly mentioned in the assessment e.g. daytime/night-time noise. For cumulative effects, where construction timing and phasing is not known, it has been assessed under the assumption that there is an overlap in the construction phases.

15.10 Summary

15.10.1 A slight adverse in-combination effect, which is not significant may occur for residents at Bowl Reed during the construction phase of the Scheme due to the permanent loss of land and adverse visual impact arising during construction.

15.10.2 No in-combination effects are anticipated during the operational phase and the overall effect has been assessed as being neutral.

15.10.3 No significant cumulative effects were identified during the construction phase and the overall significance of effects was assessed as being neutral.

15.10.4 No significant cumulative effects were identified during the operational phase and the overall significance of effects was assessed as being slight adverse in the Opening Year and neutral by Design Year 15.

16. Glossary of technical terms and acronyms

Acronym	Full term
°C	Degrees Celsius
AADT	Annual Average Daily Traffic – The number of vehicles travelling on a particular stretch of road on an average day.
ADMS Roads	A comprehensive software tool for investigating air pollution problems due to networks of roads that may be in combination with industrial sites.
Affected Road Network (ARN)	The parts of the road network that would be affected by a change in traffic levels as the result of a transport scheme
ALC	Agricultural Land Classification – A framework for classifying land according to the extent to which its physical or chemical characteristics impose long term limitations on agricultural use. Agricultural land is classified into five categories according to versatility and suitability for growing crops. The top three grades, Grade 1, 2 and 3a, are referred to as 'Best and Most Versatile' land.
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area – An area identified where the National Air Quality Objectives are not likely to be achieved. The Local Authority is required to produce a Local Air Quality Action Plan to plan how air quality in the area is to be improved.
AQS	Air Quality Strategy – The AQS sets out air quality objectives and policy options to further improve air quality in the UK from today into the long term.
Annual Average Daily Traffic (AADT)	The number of vehicles travelling on a particular stretch of road on an average day.
AONB	Area of Outstanding Natural Beauty – An area outside a National Park designated for conservation due to its natural beauty.
ARN	Affected Road Network – The parts of the road network that would be affected by a change in traffic levels as the result of a transport scheme.
At grade	On the same level, for example, an at grade junction is two or more roads meeting or crossing on the same level.
BAP	Biodiversity Action Plan - An internationally recognized program addressing threatened species and habitats and is designed to protect and restore biological systems. The original impetus for these plans derives from the 1992 Convention on Biological Diversity.
BGS	British Geological Survey - A partly publicly-funded body which aims to advance geoscientific knowledge of the United Kingdom landmass and its continental shelf by means of systematic surveying, monitoring and research.
BLM	Biotic Ligand Model
BMV	Best and Most Versatile – Defined as Grades 1, 2 and 3a of the Agricultural Land Classification as land which is most flexible, productive and efficient in response to inputs and which can best deliver future crops for food and non-food uses such as biomass, fibres and pharmaceuticals.

Acronym	Full term
BNL	Basic Noise Level
BoCC	Red listed birds of conservation concern
BPM	Best practicable means
BS	British Standard
Campaign to Protect Rural England (CPRE)	A national charity dedicated to the protection of rural England, protecting the local countryside where there is threat and enhancing it where there is opportunity. They aim to limit urban sprawl and ribbon development.
CD&E	Construction, Demolition & Excavation
CEA	Cumulative Effects Assessment
CEMP	Construction Environmental Management Plan - A plan by the contractor describing how the environmental impacts of construction activities of a project will be minimised and mitigated.
CIBSE	Chartered Institute of Building Service Engineers
CIRIA	Construction Industry Research and Information Society
CIWEM	Chartered Institution of Water and Environmental Management
CLP	Classification, labelling and packaging
CMS	Continuous Monitoring Stations - An air quality monitoring station that houses analysers that continuously monitor the concentrations of air pollutants.
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalent
COMAH	Control of Major Accident Hazards
Conservation Area	An area of special environmental or historic interest or importance, of which the character or appearance is protected by law against undesirable changes (Section 69 of the Planning (Listed Buildings and Conservation Areas) Act 1990).
COSHH	Control of Substances Hazardous to Health - Under the Control of Substances Hazardous to Health Regulations 2002, employers need to either prevent or reduce their workers' exposure to substances that are hazardous to their health.
Contaminated Land Report 11 (CLR11)	The Model Procedures for the Management of Land Contamination (CLR 11) have been developed to provide the technical framework for applying a risk management process when dealing with land affected by contamination. The process involves identifying, making decisions on, and taking appropriate action to deal with land contamination in a way that is consistent with government policies and legislation within the UK.
County Wildlife Site (CWS)	A non-statutory conservation designation in the UK which affirms a site's importance and value for wildlife in its county context. The designation is classified by Natural England as being a 'Local Site' designation, though sites can also be of a regional and national importance.
CRoW	Countryside and Rights of Way
CRTN	Calculation of Road Traffic Noise – Method of calculating (and measuring) road traffic noise levels for new and altered highways.

Acronym	Full term
cSAC	Candidate Special Area of Conservation
CSM	Conceptual Site Model - Serves to conceptualize the relationship between contaminant sources and receptors through consideration of potential or actual migration and exposure pathways.
dB	Decibel
DCLG	Department for Communities and Local Government
DECC	Department for Energy and Climate Change
DEFRA	Department of the Environment, Food and Rural Affairs - Defra is the government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the United Kingdom of Great Britain and Northern Ireland. Defra is a ministerial department, supported by 33 agencies and public bodies.
DfT	Department for Transport - Government department responsible for the transport network in England, and for aspects of the transport network in the devolved administrations.
Disasters	A sudden accident or a natural catastrophe that causes great damage or loss of life.
DM	'Do Minimum'
DMRB	Design Manual for Roads and Bridges - A series of 15 volumes that provide standards, advice notes and other published documents relating to the design, assessment and operation of trunk roads, including motorways in the United Kingdom, and, with some amendments, the Republic of Ireland.
DS	'Do Something'
EA	Environment Agency - A non-departmental public body with responsibilities relating to the protection and enhancement of the environment in England.
EC	European Community
ECoW	Ecological Clerk of Works
EEA	European Economic Area
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
English Heritage	Charity that cares for the National Heritage Collection of state-owned historic sites and monuments across England, under licence from Historic England.
EPSM	European Protected Species Mitigation
EQS	Environmental Quality Standards
ES	Environmental Statement
ESR	Environmental Scoping Report
EU	European Union
EZol	Ecological Zone of Influence - the area in which there may be ecological features subject to impacts and subsequent effects as a result of the Scheme, including those that would occur as a

Acronym	Full term
	result of habitat loss, and those that would occur through disturbance, such as noise.
Extreme weather	A weather event that falls outside the realm of normal weather patterns.
FRA	Flood Risk Assessment
GAC	Generic Assessment Criteria
GHG	Greenhouse Gas
GI	Ground Investigation
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GQRA	Generic quantitative risk assessments
H++	The results of a project to investigate the development of plausible high end climate change scenarios
HADDMs	Highways Agency Drainage Data Management System
HAGDMS	Highways Agency Geotechnical Data Management System
HAWRAT	Highways Agency Water Risk Assessment Tool
HDV	Heavy Duty Vehicles/Heavy Delivery Vehicles
HER	Historic Environment Record
HGVs	Heavy Good Vehicles
HIA	Health Impact Assessment
Historic England	Publicly funded body that champions and protects England's historic places, including Stonehenge and Avebury; also known as the Historic Buildings and Monuments Commission for England.
HLC	Historic Landscape Character
HPI	Habitats of Principal Importance - Under Section 41 of the Natural Environment and Rural Communities (NERC) Act, the Secretary of State is required to publish a list of habitats which are of principal importance for the conservation of biodiversity in England. Fifty-six habitats of principal importance are included on the S41 list. These are all the habitats in England that were identified as requiring action in the UK Biodiversity Action Plan and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework.
HRA	Habitats Regulation Assessment
IAN	Interim Advice Note - Contains specific guidance, which shall only be used in connection with works on motorways and trunk roads in England, subject to any specific implementation instructions contained within an IAN.
IEMA	Institute of Environmental Management and Assessment
JNCC	Joint Nature Conservation Committee
KBAP	Kent Biodiversity Action Plan
KCC	Kent County Council
KHER	Kent Historic Record
KMBRC	Kent and Medway Biological Record Centre

Acronym	Full term
KWh	Kilowatt hours
LAQM.TG	Local Air Quality Management Technical Guidance - A technical guidance document designed to support local authorities in carrying out their duties under the Environment Act 1995 and subsequent Regulations. These duties require local authorities to review and assess air quality in their area from time to time.
LDV	Light delivery vehicle
LED	Light emitting diode
Limit Values	Refers to airborne concentrations of chemical substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse health effects.
LLFAs	Lead Local Flood Authorities
LNR	Local Nature Reserve - A statutory designation made under Section 21 of the National Parks and Access to the Countryside Act 1949. and amended by Schedule 11 of the Natural Environment and Rural Communities Act 2006, by principal local authorities. A Local Nature Reserve must be of importance for wildlife, geology, education or public enjoyment.
LOAEL	Lowest Observed Adverse Effect Level
Local Enterprise Partnership (LEP)	A voluntary partnership set up between local authorities and businesses to drive local economic growth and job creation activities. There are 39 LEPs across England.
LWS	Local Wildlife Site
MAFF	Ministry of Agriculture, Fisheries and Food - A UK government department created by the Board of Agriculture Act 1889. The Ministry was dissolved in 2002, at which point its responsibilities were merged into the Department for Environment, Food and Rural Affairs (Defra).
MAGIC	Multi-Agency Geographic Information for the Countryside - A web-based interactive map to bring together information on key environmental schemes and designations in one place. Multi-Agency Geographic Information for the Countryside (MAGIC) is a partnership project involving six government organisations who have responsibilities for rural policy-making and management.
Mineral Safeguarding Area	An area designated by Minerals Planning Authorities which covers known deposits of minerals which are desired to be kept safeguarded from unnecessary sterilisation by non-mineral development.
MOU	Measure of Uncertainty
MMP	Materials Management Plan
Multi-Agency Geographic Information for the Countryside	A web-based interactive map to bring together information on key environmental schemes and designations in one place. Multi-Agency Geographic Information for the Countryside (MAGIC) is a partnership project involving six government organisations who have responsibilities for rural policy-making and management.
National Trust	Charity that cares for historic houses, gardens, ancient monuments, countryside and other sites across England, Wales and Northern Ireland, including the Stonehenge landscape.

Acronym	Full term
National Vegetation Classification (NVC)	The National Vegetation Classification was commissioned in 1975 by the Nature Conservancy Council (NCC) to provide a comprehensive and systematic catalogue and description of the plant communities of Britain. It has now been accepted as a standard, not only by the nature conservation and countryside organisations, but also by forestry, agriculture and water agencies, local authorities, nongovernmental organisations, major industries and universities.
NCA	National Character Area - The subdivision of England into 159 distinct natural areas. Each area is defined by a unique combination of landscape, biodiversity, geodiversity, history, and cultural and economic activity. Their boundaries follow natural lines in the landscape rather than administrative boundaries.
NE	Natural England - Executive non-departmental public body responsible for the natural environment.
NHBC	National House Building Council
NHLE	National Heritage List for England
NIA	Noise Important Area - Areas where the 1% of the population that are affected by the highest noise levels from major roads are located according to the results of Defra's strategic noise maps.
NMU	Non-Motorised User - Cyclists, pedestrians (including wheelchair users), and equestrians using the public highway.
NN NPS	National Networks National Policy Statement
NNR	National Nature Reserves - Reserves established to protect some of the most important habitats, species and geology in the United Kingdom, and to provide ‘outdoor laboratories’ for research. There are currently 224 NNRs in England with a total area of over 94,400 hectares - approximately 0.7% of the country’s land surface. Natural England manages about two thirds of England’s NNRs. The remaining reserves are managed by organisations approved by Natural England, for example, the National Trust, Forestry Commission, RSPB, Wildlife Trusts and local authorities.
NO_2	Nitrogen Dioxide
NOEL	No Observed Effect Level
NO_x	Nitrogen Oxide
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NPSE	Noise Policy Statement for England
NPSNN	National Policy Statement for National Networks
NSIP	Nationally Significant Infrastructure Project - A project of a type and scale defined under the Planning Act 2008 and by order of the Secretary of State relating to energy, transport, water, waste water and waste generally. These projects require a single development consent. Planning permission, listed building consent and scheduled monument consent amongst others are not required for Nationally Significant Infrastructure Projects.
OEMP	Outline Environmental Management Plan
OS	Ordnance Survey

Acronym	Full term
PAHs	Polycyclic Aromatic Hydrocarbons
PCL	Potential Contaminant Linkages
PCM	Pollution Climate Mapping - A collection of models designed to fulfil part of the United Kingdom's EU Directive (2008/50/EC) on ambient air quality and cleaner air for Europe, requirements to report on the concentrations of particular pollutants in the atmosphere. There is one model per pollutant, each with two parts: a base year model and a projections model. The Pollution Climate Mapping model provides outputs on a 1x1 km grid of background conditions plus around 9,000 representative road side values. The Mapping is also used for scenario assessment and population exposure calculations to assist policy developments and provides model runs to support the writing of Time Extension Notification applications for PM_{10} and NO_x.
PCSM	Preliminary Conceptual Site Model
PINS	Planning Inspectorate
PM_{10}	Particulate Matter with a diameter of 10 micrometres or less
PM_{25}	
PPE	Personal Protective Equipment
PPGs	Pollution Prevention Guidelines
PPV	Peak particle velocity
PRoW	Public Right of Way - A way over which the public have a right to pass and repass. The route may be used on foot, on (or leading) a horse, on a pedal cycle or with a motor vehicle, depending on its status. Although the land may be owned by a private individual, the public may still gain access across that land along a specific route. Public rights of way are all highways in law.
pSAC	Possible Special Area of Conservation
PSSR	Preliminary Sources Study Report
RAMS	Risk Assessment, Method Statement
RBD	River Basin District (RBD)
RBMPs	River Basin Management Plans
RIS	Road Investment Strategy - The long-term strategy to improve England’s motorways and major A roads. The first RIS (known as RIS1) was published in 2014 and covers the period 2015-2020. A second RIS (RIS2) was published in 2015, and covers the post-2020 period.
SAC	Special Area of Conservation - Areas of strictly protected sites designated under the EC Habitats Directive (92/43/EEC) on the conservation of natural habitats and of wild fauna and flora. The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds).
Scheduled monument	A 'nationally important' archaeological site or historic building, given protection against unauthorised change and included in the Schedule of Monuments kept by the Secretary of State for Culture, Media and Sport. The protection given to scheduled

Acronym	Full term
	monuments is given under the Ancient Monuments and Archaeological Areas Act 1979.
SEB	Statutory Environmental Bodies
SNCI	Sites of Nature Conservation Importance - Locally important sites of nature conservation adopted by local authorities for planning purposes.
SOAEL	Significant Observed Adverse Effect Level
SPA	Special Protection Area - Areas of strictly protected sites classified in accordance with Article 4 of the EC Birds Directive (2009/147/EC) on the conservation of wild birds. They are classified for rare and vulnerable birds (as listed on Annex I of the Directive), and for regularly occurring migratory species.
SPI	Species of Principal Importance
SPZ	Source Protection Zone - Areas of land around over 2000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. The zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. There are three main zones (inner, outer and total catchment) and a fourth zone of special interest, which is occasionally applied to a groundwater source. The zones are used in conjunction with the Groundwater Protection Policy to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby.
SSSI	Site of Special Scientific Interest - A conservation designation denoting to a protected area in the United Kingdom. The Sites are protected by law to conserve their wildlife or geology.
Strategic Economic Plan	A document produced by a Local Enterprise Partnership setting out its plans for the future and the funding that will be required to deliver these plans.
Strategic Road Network	The network of approximately 4,300 miles of motorways and major ‘trunk’ A roads across England, managed by Highways England.
SuDS	Sustainable Urban Drainage Systems
SWMP	Site Waste Management Plan - A Site Waste Management Plan should describe how materials will be managed efficiently and disposed of legally during the construction of the works, explaining how the re-use and recycling of materials will be maximised. This involves estimating how much of each type of waste is likely to be produced and the proportion of this that will be re-used or recycled on site, or removed from the construction site for re-use, recycling, recovery or disposal. It is the joint responsibility of the client and the principal contractor to ensure that a Site Waste Management Plan is in place before construction begins and to ensure that it is enforced.
TAG	Transport Analysis Guidance - Guidance produced by DfT on the process of appraisal of transport interventions.
TIN	Technical Information Note

Acronym	Full term
The Scheme	The M2 Juncyion 5 Scheme.
TPA	Tonnes per Annum
Tree Preservation Order (TPO)	A Tree Preservation Order is made by a Local Planning Authority to protect specific trees or a particular area, group or woodland from deliberate damage and destruction. TPOs can prevent the felling, lopping, topping, uprooting or otherwise wilful damaging of trees without the permission of the Local Planning Authority.
UAEL	Unacceptable Adverse Effect Levels
UK	United Kingdom
UKCP	United Kingdom Climate Predictions
UXO	Unexploded Ordnance - An explosive weapon (bombs, shells, grenades, land mines, naval mines, cluster munition, etc.) that did not explode when they were employed and still pose a risk of detonation, sometimes many decades after they were used or discarded.
WEEE	Waste electrical and electronic equipment
WFD	Water Framework Directive - The Water Framework Directive (2000/60/EC) is a EU directive which aims to achieve good status of all water bodies (surface waters, groundwaters and the sites that depend on them, estuaries and near-shore coastal waters) and the prevent any deterioration. It has introduced a comprehensive river basin management planning system to protect and improve the ecological quality of the water environment. It is underpinned by the use of environmental standards.
WHO	World Health Organisation
World Heritage Site	A site listed by UNESCO because of its special natural or cultural value.
WPZ	Water Protection Zone
WRAP	Waste and Resources Action Plan
Vulnerability	The quality or state of being exposed to the possibility of being attacked or harmed, either physically or emotionally.
ZoI	Zone of Influence
ZVI	Zone of Visual Influence

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