A303 Sparkford to Ilchester Dualling Scheme TR010036

6.1 Environmental Statement

Chapter 9 Geology and Soils

APFP Regulation 5(2)(a)
Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
July 2018

Volume 6.0

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A303 Sparkford to Ilchester Dualling Scheme

Development Consent Order 201[X]

6.1 Environmental Statement
Chapter 9 Geology and Soils

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Table of Contents

9 Geology and Soils

9.1 Introduction

9.1.1 This chapter considers the potential likely significant effects of the proposed A303 Sparkford to Ilchester Dualling scheme (hereafter referred to as 'the scheme') on geology and soils, including any contaminated land and mineral resources present, contaminated waste (soils), and any potential associated effects on groundwater and surface water quality from a contaminated land perspective.

9.1.2 This assessment has been undertaken in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 11 *Geology and Soils*[1]. The effects of the scheme upon agricultural land have been assessed in Chapter 12 People and Communities of Volume 6.1, and are not considered in this chapter. The effects of materials import and export in relation to earthworks construction are considered in Chapter 11 Material Assets and Waste of Volume 6.1.

9.1.3 Chapter 2 The Scheme of Volume 6.1 contains a detailed description of the scheme. The supporting figures referenced in this chapter can be found in Volume 6.2, while the technical appendices are presented in Volume 6.3.

9.2 Competent expert evidence

9.2.1 The competent expert holds a master's level degree in Environmental Geology, is a Chartered Geologist, a Qualified Person under CL:AIRE Definition of Waste Code of Practice, and is a Full Member of the British Society of Soil Science (MI Soil Sci). The competent expert has over 17 years' postgraduate experience as a geo-environmental specialist, with 10 years' experience in the production of geology and soils technical Environmental Statement (ES) chapters.

9.3 Legislative and policy framework

9.3.1 The principal legislative and planning context for the assessment of the effects of the scheme on geology and soils is presented below.

[1] Highways England (1993) Design Manual for Roads and Bridges Volume 11 Section 3 Part 11 *Geology and Soils* [online] available at: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/11s3p11.pdf (last accessed May 2018).

European legislation

The Water Framework Directive (EU Directive 2000/60/EC) and associated national implementation regulations

9.3.2 Aims to protect inland and coastal waters and prevent deterioration of aquatic ecosystems, including groundwaters. A key aim of the *Water Framework Directive* (WFD) is to achieve 'good' ecological status for all waterbodies by 2015, with a secondary aim to gradually reduce the release of pollutants which may pose significant risks to the aquatic ecosystems. The environmental objectives for the WFD are implemented through actions described in the *River Basin Management Plans* (RBMPs).

The Groundwater Daughter Directive (2006/118/EC) transposed into law in England & Wales through the Groundwater Regulations (2009)

9.3.3 Establishes specific measures in order to prevent and control groundwater pollution including: criteria for assessing the chemical status of groundwater; criteria for identifying significant and sustained upward trends in groundwater pollution levels, and for defining starting points for reversing these trends; and preventing and limiting indirect discharges (after percolation through soil or subsoil) of pollutants into groundwater. The *Groundwater Daughter Directive* (GDD) clarifies certain objectives of the WFD relating to prevention and control of groundwater pollution and establishes groundwater quality standards.

National legislation

Part IIA of the Environmental Protection Act

9.3.4 The *Environmental Protection Act* (EPA) principally applies to sites where individual historical contamination linkages present a Significant Possibility of Significant Harm (SPOSH) or a Significant Possibility of Significant Pollution to Controlled Waters (SPOSPCoW) representing an unacceptable level of contamination risk for each linkage. The Part IIA clean-up is the minimum which can be done on a cost basis to make and keep the site in a just safe condition for an existing use.

The Contaminated Land (England) Regulations 2006 (as amended)

9.3.5 The *Contaminated Land (England) Regulations* set out provisions relating to the identification and remediation of contaminated land under Part IIA of the EPA. The Regulations make provision for an additional description of contaminated land that is required to be designated as a special site where the Environment Agency is to be the enforcing authority.

The Water Resources Act 1991

9.3.6 Risks from historical groundwater pollution can be considered under Section 161 of the *Water Resources Act* (WRA). This allows the Environment Agency to recover the costs of cleaning up any poisonous, noxious or polluting matter or any solid waste matter that persons have caused or knowingly permitted to be present in controlled waters. The WRA and WRA 1991 (amendment) (England and Wales) Regulations 2009, Section 93, provides for the establishment of water protection zones.

Wildlife and Countryside Act 1981 (as amended)

9.3.7 Geological and geomorphological features considered to be of national importance are designated as Sites of Special Scientific Interest (SSSI). The importance of nature conservation, including areas with geological features, is emphasised.

Environmental Permitting (England and Wales) Regulations 2016

9.3.8 The prevention of pollution is regulated by several pieces of legislation including the *Environmental Permitting Regulations*, which regulate pollution control by requiring permits for emissions to, for example, air and water.

Waste legislation (various)

9.3.9 There are also a number of waste-related regulations which serve to protect soils from contamination by waste management, such as the *Hazardous Waste (England and Wales) Regulations 2005* (as amended), *Environmental Protection (Duty of care) Regulations 1991*, *Waste Management Licensing Regulations 1994* (as amended), *Landfill Directive 1999*, *Landfill Tax (Contaminated land) Order 1996, Landfill (England and Wales) Regulations 2002* (as amended), and the *Waste (England and Wales) Regulations 2011* (as amended).

9.3.10 Additional information relating to waste legislation is contained within section 10.3 of Chapter 10 Material Assets and Waste, Volume 6.1.

Other regulations (various)

9.3.11 Under the *Control of Substances Hazardous to Health Regulations 2002* (COSHH) and the *Construction Design and Management (CDM) Regulations 2015*, where a developer knows or suspects the presence of contaminated soil, provision would be made to ensure that risks to the public and site workers are minimised.

National planning policy

National Policy Statement for National Networks

9.3.12 In the context of this assessment, the *National Policy Statement for National Networks* (NPSNN)[2] states the following:

9.3.13 *"Where possible, developments should be on previously developed (brownfield) sites provided that it is 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."*

9.3.14 *"Where the project is subject to EIA the applicant should ensure that the environmental statement clearly sets out any likely significant effects on internationally, nationally and locally designated sites of ecological or geological conservation importance…The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests."*

9.3.15 *"Development should avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives."*

The National Planning Policy Framework 2012

9.3.16 The *National Planning Policy Framework* (NPPF)[3] provides guidance to authorities regarding the minimisation of impacts on geodiversity and prevention of harm to geological conservation interests. The NPPF contains the national planning policy on these and other matters that should be reflected in local development plans and / or to inform decision making by local authorities on applications for planning permission.

9.3.17 As most sites impacted by historical contamination are not determined as "Contaminated Land" under Part IIA of the EPA, the remediation of any contamination present is generally managed through the planning regime. The NPPF provides guidance on contaminated land and protection from a planning perspective.

[2] Department for Transport (2014) *National Policy Statement for National Networks* [online] available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387223/npsnn-web.pdf (last accessed April 2018).
[3] Communities and Local Government (2012) *National Planning Policy Framework* [online] available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf (last accessed April 2018).

9.3.18 Paragraphs 120 and 121 of the NPPF include guidance on preventing unacceptable risks from pollution / contaminated land and land instability, along with providing guidance on minimising impacts to minerals resources.

9.3.19 Paragraph 112 of the NPPF states that Local planning authorities should take into account the economic and other benefits of the best and most versatile agricultural land. Where significant development of agricultural land is demonstrated to be necessary, local planning authorities should seek to use areas of poorer quality land in preference to that of a higher quality.

Local policy

South Somerset District Council Local Plan 2006-2028

9.3.20 South Somerset District Council's *Local Plan*[4] contains Policy EQ7 Pollution Control which is relevant to contaminated land. In addition, the Local Plan is relevant to the protection of geological assets.

9.3.21 The scheme runs through ALC Grade 3 land, there are no polices within the Local Plan with regards to agricultural land as it is covered in the NPPF Paragraph 112 as detailed above in paragraph 9.3.19.

South Somerset District Council Contaminated Land Statement

9.3.22 Within South Somerset District Council's *Contaminated Land Statement*, the Council aims to "*ensure that contaminated land does not cause unacceptable risks to human health, property and the wider natural environment. Where land is causing such risks, we (South Somerset District Council) will aim to secure appropriate mitigation or remediation*".

Somerset Waste Core Strategy: Development Plan Document up to 2028

9.3.23 The Somerset *Waste Core Strategy (February 2015)* guides the County Council's approach to planning for sustainable waste management in Somerset until the year 2028. It covers all forms of waste including household, commercial, industrial and construction waste.

9.3.24 There are some historical landfills located within 250 metres of the scheme which are addressed further in paragraph 9.7.62. There are no active waste facilities in the vicinity of the scheme.

[4] South Somerset District Council (2015) South Somerset Local Plan (2006 – 2028) [online] available at: https://www.southsomerset.gov.uk/media/707200/south_somerset_local_plan_2006-2028_adoption_version_march_2015.pdf (last accessed July 2018).

Somerset Minerals Plan: Development Plan Document up to 2030

9.3.25 The *Somerset Minerals Plan*[5] is prepared and published by Somerset County Council. It is an essential tool for local decision-making on minerals development, underpinned by robust evidence and shaped to support sustainable development in Somerset. The Minerals Plan designates specific mineral extraction sites and preferred areas or areas for search where there is a known potential shortfall in supply of a particular aggregate.

9.3.26 Policy SMP9 refers to a list of exemptions, set out in Table 6 of the Minerals Plan. This includes an exemption for development with a demonstrable over-riding need, where prior extraction is not practicable and / or viable. The scheme is identified as a key priority for facilitating economic growth in the south west of England. NPSNN states that there is a critical need to improve national networks to address road congestion and Highways England's *Road Investment Strategy* (RIS)[6] includes the A303 Sparkford to Ilchester improvement scheme as a priority for investment. Therefore, there is national policy support for the scheme, which is considered to demonstrate an over-riding need for the scheme.

9.4 Assessment methodology

9.4.1 This section describes the methodology which has been used for the assessment of geology and soils (including contaminated land, contaminated waste, mineral resources and groundwaters) which may affect, or be affected by, the construction of the scheme.

9.4.2 The methodology was presented within Chapter 10 of the ***Environmental Impact Assessment (EIA) Scoping Report* (*document reference: HE551507-MMSJV-EGN-000-RP-LP-0014*)** issued to the Planning Inspectorate in November 2017. The Scoping Opinion is contained within Appendix 4.1 of Volume 6.3. A schedule of responses detailing how each of the Scoping Opinion comments have been considered as part of this chapter is contained within Appendix 4.2 of Volume 6.3. No amendments to the methodology as presented within the EIA Scoping Report has been necessary.

9.4.3 In line with the ***EIA Scoping Report* (*document reference: HE551507-MMSJV-EGN-000-RP-LP-0014*)** the operational phase of the scheme has been scoped out of the assessment. This is because there are the minimal anticipated direct effects on geology and soils during the operational period, as agreed by the Planning Inspectorate within the Scoping Opinion (Appendix 4.1

[5] Somerset County Council (2015) *Somerset Minerals Plan: Development Plan Document up to 2030* [online] available at: http://www.somerset.gov.uk/policies-and-plans/plans/somerset-minerals-plan/ (last accessed July 2018).
[6] Highways England (2015) Road Investment Strategy: 2015 to 2020 [online] available at: https://www.gov.uk/government/collections/road-investment-strategy (last accessed July 2018).

of Volume 6.3). Only the construction phase remains scoped in to this assessment.

9.4.4 The assessment has been undertaken in accordance with the principles set out in Chapter 4 Environmental Assessment Methodology in Volume 6.1. The methodology for assessment has been based on the following guiding documents.

9.4.5 DMRB Volume 11 Section 3 Part 11 *Geology and Soils*[7] provides guidance on the assessment of the potential impact of road schemes on geology and soils, and the constraints existing site conditions can impose on proposed development.

9.4.6 The framework for the assessment of potential land contamination is based on current guidance documents regarding the implementation of Part IIA of the EPA and the assessment of potentially contaminated land, with particular reference to:

- *Environmental Protection Act 1990*: *Part 2A, Contaminated Land Statutory Guidance*[8].
- *Human Health Toxicological Assessment of Contaminants in Soil*[9].
- Model Procedures for the Management of Land Contamination CLR11[10].
- Updated technical background to the CLEA Model[11].
- BS 10175:2011+A1:2013, *Investigation of Potentially Contaminated Sites*. Code of Practice[12.]
- BS 8485:2015, *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*[13].
- Groundwater protection guides covering: requirements, permissions, risk assessments and controls (previously covered in GP3)[14].

[7] Highways England (1993) Design Manual for Roads and Bridges Volume 11 Section 3 Part 11 *Geology and Soils* [online] available at: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/11s3p11.pdf (last accessed May 2018).
[8] Defra (2012) *Environmental Protection Act 1990*: *Part 2A, Contaminated Land Statutory Guidance*.
[9] Environment Agency (2009) *Human Health Toxicological Assessment of Contaminants in Soil*, Report ref. SC050021/SR2.
[10] Department for Environment Food and Rural Affairs / Environment Agency (2004) *Model Procedures for the Management of Land Contamination, Contaminated Land Report 11*
[11] Environment Agency (2009) *Updated technical background to the CLEA Model*, Report ref. SC050021/SR3.
[12] British Standard (2013) BS 10175:2011+A1:2013, *Investigation of Potentially Contaminated Sites*. Code of Practice.
[13] British Standard (2015) BS 8485:2015, *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*.
[14] Environment Agency (2017) G*roundwater protection guides covering: requirements, permissions, risk assessments and controls* (previously covered in GP3).

9.4.7 The approach for geology and soils follows the guidance presented within DMRB Volume 11 Section 2 Part 5 HA (205/08)[15] to a Simple level, along with professional judgment. The outcome has been used to aid the development of appropriate mitigation measures in order to avoid or reduce potential adverse effects.

Sensitivity of receptors

9.4.8 The sensitivity (value) of receptors has been determined according to the descriptions provided within Table 9.1.

9.4.9 For contaminated land, the sensitivity categories are derived based on the classification published by the National House Building Council (NHBC), the Environment Agency, and Chartered Institute of Environmental Health (CIEH)[16].

Table 9.1: Scale for evaluating the sensitivity (value) of receptors

Sensitivity	Criteria	Typical examples
Very High	International scale: Very high importance and rarity and very limited potential for substitution	Important on a European or global level: • Geology: World Heritage Sites (WHS). • Soils: Agricultural soils of Grade 1 quality. • Minerals: Energy minerals – minerals used to generate energy such as coal oil and gas. • Controlled Water: Groundwater vulnerability is classified as high; Principal aquifer providing a regionally important resource or supporting site protected under wildlife legislation; or SPZ I. • Future site users: Very sensitive land uses proposed such as residential housing with gardens, allotments. • Built environment: Sites of international Importance, World Heritage Sites.
High	National scale: High importance and rarity, limited potential for substitution	Important in the UK: • Geology: Site protected under EU or UK wildlife legislation (Special Areas of Conservation (SAC), Special Protection Areas (SPA), SSSIs, Ramsar sites). • Soils: Agricultural soils of Grade 2 quality. • Minerals: Poor quality energy minerals or silica (industrial) sand for use in glass making. • Controlled Water: Groundwater vulnerability is classified as high; Principal aquifer providing locally important resource or supporting river ecosystem; SPZ II. • Future site users: Sensitive land uses proposed such as schools, residential housing without gardens, open spaces. • Built environment: Listed buildings, Scheduled Monuments.
Medium	Regional scale: Medium quality and rarity	Important in the context of the south west of England: • Geology: Regionally Important Geological Sites (RIGS). • Soils: Agricultural soils of Grade 3 quality. • Minerals: Construction aggregates – minerals used in building and engineering or to manufacture building and engineering products such as concrete.

[15] Highways England (2008) Design Manual for Roads and Bridges Volume 11 Section 2 Part 5 *Assessment and Management of Environmental Effects* (HA205/08) [online] available at: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section2/ha20508.pdf (last accessed March 2018).

[16] *Developed from DOE Guide to Risk Assessment and Risk Management for Environmental Protection and the Statutory Guidance on Contaminated Land* (Defra September 2006).

Sensitivity	Criteria	Typical examples
		• Controlled Water: Moderate classification of groundwater vulnerability; Secondary aquifer providing water for agricultural or industrial use with limited connection to surface water; SPZ III. • Future site users: Moderately sensitive land uses such as commercial developments and open spaces. • Built environment: Sites with local interest for education or cultural appreciation.
Low	District scale: Low quality and rarity	Important in the context of south Somerset: • Geology: Rock exposures. • Soils: Agricultural soils of Grade 4 - 5 quality. • Minerals: Poor quality materials suitable for us as general fill only. • Controlled water: Deep Secondary aquifer with poor water quality not providing baseflow to rivers; Aquifer not used for water supplies (public or private). • Future site users: Low sensitivity land use such as Industrial Sites, highways and rail. • Built environment: Infrastructure (for example roads, railways, tramways).
Negligible	Local scale: Very low importance and rarity	Important within and adjacent to site (within approximately 2 kilometres): • Geology: No rock exposures. • Soils: Urban classified soils. • Minerals: No minerals. • Controlled Water: Non-aquifer. • Future site users: No sensitive land use proposed.

Source: Adapted from DMRB Volume 11 Section 2 Part 5 HA (205/08)

Magnitude of impact

9.4.10 The magnitude of impact is determined by the predicted deviation from the baseline conditions and the scale of the effect. The qualitative magnitude of each impact (in the absence of quantitative data) has been determined according to the descriptions provided within Table 9.2.

Table 9.2: Scale for evaluating the magnitude with respect to impacts on geology and soils receptors – effects can be adverse or beneficial

Magnitude of effect	Geological changes	Soils including contaminated soils	Human health	Groundwater*	Surface water*
Major	Major disturbance or loss of geological features of interest, for example change in condition status of geological SSSI or RIGS. Major permanent impact on geological conditions.	Generation of large volume of hazardous material for disposal off-site or treatment. Physical removal or degradation of a large area of soil. Remediation / improvement of a large area of soil.	Site investigation data indicating severe contamination. Quantitative or qualitative risk assessment data estimating a significant likelihood of adverse / beneficial impacts from exposure / reduction in exposure to pollutants in	Significant change in groundwater quality with respect to Drinking Water Standards (DWS). Pollution / treatment of potable source. Any pollution inside Zone 1 or a groundwater protection zone of special interest.	Significant change in water quality, impacting quality with respect to Environmental Quality Standards (EQS). Loss of attribute and / or quality or function for example loss or extensive change to a fishery.

Magnitude of effect	Geological changes	Soils including contaminated soils	Human health	Groundwater*	Surface water*
	Sterilisation of 50% or more of mineral asset.		the environment.		
Moderate	Disturbance or loss of geological feature. Permanent impact on geological conditions. Sterilisation of 15-50% of mineral asset.	Generation of hazardous / non-hazardous material for disposal off-site or treatment. Physical removal or degradation of a moderate area of soil. Remediation / improvement of a moderate area of soil.	Site investigation data indicating moderate contamination. Quantitative or qualitative risk assessment data estimating medium risk of adverse / beneficial impacts from exposure / reduction in exposure to pollutants.	Moderate changes insufficient to change water quality with respect to DWS.	Moderate changes insufficient to change water quality with respect to EQS. Moderate decline in the attribute quality or function.
Minor	Minor disturbance or loss of geological feature. Minor permanent impact on geological conditions. Sterilisation of <15% of mineral asset.	Generation of inert non-hazardous waste materials which may be suitable for re-use on site. Physical removal or degradation of a minor area of soil. Remediation / improvement of a minor area of soil.	Site investigation data indicating significant contamination is unlikely. Quantitative and qualitative risk assessment data estimating low likelihood of adverse / beneficial impacts from exposure / reduction in exposure.	Minor impact insufficient to impact on characteristics of water resource.	Measurable change in water quality but no change with respect to EQS or minor. Negligible decline in attribute quality or function.
Low	Physical removal, degradation (including loss of structure and contamination) or improvement of a very minor area of soil. Minimal impact on geological conditions and minerals assets.				
Negligible	No loss or alteration of characteristics, features or elements; no observable impact in either direction.				

* In relation to quality changes associated with the mobilisation and transport of contaminants.

Source: Adapted from DMRB Volume 11 Section 2 Part 5 HA (205/08)[17].

[17] Highways England (2008) Design Manual for Roads and Bridges Volume 11 Section 2 Part 5 *Assessment and Management of Environmental Effects* (HA205/08) [online] available at: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section2/ha20508.pdf (last accessed March 2018).

Significance of effect

9.4.11 Subsequent to identifying an appropriate receptor sensitivity and magnitude of impact using Table 9.1 and Table 9.2, the likely significance category and overall significance of effects has been assessed by using the matrix and table provided within Table 9.3 and typical descriptors provided within Table 9.4 respectively, along with professional judgment to consider site specific factors that may be of relevance. For the purposes of this assessment, effects of Moderate Adverse or Beneficial and above have been considered to be significant.

Table 9.3: Scale for evaluating the significance category with respect to impacts on geology and soils receptors – effects can be adverse or beneficial

Magnitude of potential impact	Sensitivity (value) of receptor				
	Very high	**High**	**Medium**	**Low**	**Negligible**
Major	Very large	Large / Very Large	Moderate / Large	Slight / Moderate	Slight
Moderate	Large / Very Large	Moderate / Large	Moderate	Slight	Neutral / Slight
Minor	Moderate / Large	Slight / Moderate	Slight	Neutral / Slight	Neutral / Slight
Negligible	Slight	Slight	Neutral / Slight	Neutral / Slight	Neutral
No Change	Neutral	Neutral	Neutral	Neutral	Neutral

Source: Adapted from DMRB Volume 11 Section2 Part 5 HA (205/08)

Table 9.4: Scale for evaluating the significance of effects

Significance category	Criteria	Typical examples
Neutral	Not applicable	• Minimal effect on geological condition. • Minor loss of urban soils. • No discernible negative effect to buildings / infrastructure.
Slight	Adverse	• Changes to Made Ground deposits only. • Moderate/major loss/degradation of Grade 4 or 5 soils. • Minor / moderate loss/degradation of Grade 3 soils. • Easily preventable, non-permanent health effects on humans. • Minor low-level and localised contamination of on-site soils. • Easily reparable damage to buildings / infrastructure.
	Beneficial	• Remediation of localised low levels of contamination. • Remediation of non-sensitive water resource. • Contamination. • Minimal improvements to overall soil and water quality.
Moderate	Adverse	• Superficial disturbance to near surface deposits. • Changes in geomorphology, large loss/degradation of Grade 3 soils. • Minor loss/ degradation of Grade 1 or 2 soils. • Sterilisation of low quality mineral resources. • Easily preventable, permanent health effects on humans. • Pollution of non-sensitive water resource or Low long-term risk of pollution to sensitive water resource. • Localised damage to buildings/infrastructure (on or off site).
	Beneficial	• Remediation of localised moderate levels of contamination.

Significance category	Criteria	Typical examples
		• Remediation of moderate, localised sensitive water resource contamination.
Large	Adverse	• Moderate / large loss / degradation of Grade 2 soils; • Moderate loss / degradation of Grade 1 soils. • Sterilisation of high quality mineral resource. • Medium / long-term (chronic) risk to human health. • Medium long-term risk of pollution of sensitive water resources. • Contamination of off-site soils.
	Beneficial	• Remediation of localised high levels of contamination. • Remediation of significant localised sensitive water resource contamination.
Very Large	Adverse	• Loss of exposed designated geological feature or large loss / degradation of Grade 1 soils. • Short-term (acute) risk to human health. • Short- term risk of pollution of sensitive water resources. • Catastrophic damage to buildings / infrastructure.
	Beneficial	Remediation of significant, widespread elevated levels of soil contamination / sensitive water resource contamination.

Source: Adapted from DMRB Volume 11 Section 2 Part 5 HA (205/08)

Consultation

9.4.12 No additional consultation specific to geology and soils has been required. Scheme-wide consultation details are provided in Section 5.5 of Chapter 4 Environmental Assessment Methodology, Volume 6.1.

9.5 Assessment assumptions and limitations

9.5.1 The geology and soils assessment has been based on the description of the scheme detailed in Section 2.5 of Chapter 2 The Scheme (Volume 6.1), including the horizontal and vertical limits of deviation.

9.5.2 The baseline information used within this chapter has been summarised from a variety of desk-based sources available at the time of writing, including historic ground investigation (GI) data. It should be noted that these GIs were not designed for the current scheme and do not cover the route in its entirety. Contaminated land assessment is also a risk based process. However, the data available provides valuable insight into local subsurface conditions which can be extrapolated across a wider area with a reasonable degree of confidence and has therefore been used to inform scheme design decisions to date.

9.5.3 Scheme-specific GI (completed in June 2018) will provide additional data to support and inform the scheme going forward, including the development of specific remediation measures, where necessary. The GI will provide information to establish an accurate ground model, obtain appropriate geotechnical data and to confirm the presence or absence of any contaminated ground. A copy of the GI location plan and schedule of investigative locations can be found in Appendix 9.3, Volume 6.3. Receipt of the Factual Report

following the completion of this GI will provide further clarity on the sub-surface conditions along the route. However, at the time of writing, this chapter relies on the existing desk-based information and any preliminary GI information available, as described in Section 9.7 of this chapter.

9.5.4 The mitigation measures included within this chapter take into account the fact that full GI data will be available for the route in the future and will inform supporting contaminated land risk assessments and geotechnical reporting which are needed as standard for developments of this nature. Following the GI, a Quantitative Risk Assessment (either Generic or Detailed as influenced by the GI findings) and an updated Conceptual Site Model and Remediation Strategy which, along with geotechnical assessment, will further inform the management of scheme geology and soils.

9.5.5 The outcome of the above investigations, assessments and reporting will influence the detailed design of the Remediation Strategy. Therefore, this chapter will need to be used in conjunction with future contaminated land risk assessment reporting to provide robust mitigation measures for the scheme. The results of the investigations and risk assessments will be provided during the course of the examination to support the proposed Remediation Strategy in section 9.9 below and secured in Requirement 8 of the DCO. Refer to Section 9.9 below for further details regarding mitigation.

9.6 Study area

9.6.1 The study area for the assessment of geology and soils encompasses the area over which the scheme could be reasonably expected to have an effect. With respect to geology and soils this generally only relates to the areas anticipated to be directly disturbed by the proposed works, however consideration of a wider study area outside the scheme red line boundary (Figure 2.1 Red Line Boundary, Volume 6.3) is necessary with regards to the following:

- The presence of potential off-site contamination sources which have the potential to migrate on-site (areas of landfill or historic potentially contaminative land use for example) and any sensitive off-site receptors which may feasibly be affected by the uncontrolled migration of contaminants off-site. Methods of contaminant transport may include migration of leachates and ground gases. Given that the setting of the site both historically and currently has been primarily agricultural in nature, the lack of urban development and relatively uniform underlying geological conditions, a 250 metre buffer is considered to be reasonable to capture the significant environmental impacts for the scheme. 250 metres from the scheme red line boundary is also considered to be appropriate to capture the likely extent of impact pathways.

- BS10175[18] states "*the extent of research into the history of the site will depend upon a number of factors including the complexity of past potentially contaminative uses on and adjacent to the site, the vulnerability of the site geology and local water environment*". Therefore, the study area also extends to sensitive off-site receptors which have the potential to be impacted by quality or quantity effects on underlying groundwaters as a result of scheme construction. This includes localised perched groundwaters, any aquifer units located below or down-gradient of the study area and any groundwater source protection zones (SPZs).

9.7 Baseline conditions

9.7.1 Throughout this section, reference is made to geology and soils features located in the vicinity of the scheme. Please see Sheets 1 and 2 of Figure 9.1 (Volume 6.2) which visually display the location of the features discussed in this section in relation to the scheme and current baseline mapping including the location of geological, hydrological and hydrogeological receptors. Features are discussed in relation to specific distances along the scheme chainage, which is measured and referenced in metres, and is also shown on Sheets 1 and 2 of Figure 9.1, Volume 6.2.

Sources of information

9.7.2 Sources of information used in this chapter include previous reporting that has been prepared as the scheme has been developed, historical and geological mapping and online data sources. Key sources of existing reporting are detailed below:

- A303 Sparkford to Ilchester Dualling Preliminary Sources Study Report (PSSR), included as Appendix 9.1, Volume 6.3. This report was prepared in accordance with Highways England's geotechnical reporting requirements presented in HD22/08 (Volume 4 of the DMRB)[19] and includes:
  - A desk based review of geological mapping and memoirs along with the review of information from a large number of historic reports available from the HAGDMS website[20].
  - A review of previous GI broadly located adjacent to the scheme (as it generally follows the existing road).

[18] *Investigation of potentially contaminated sites*. Code of practice. Code of practice, March 2011.
[19]Highways England (1993) Design Manual for Roads and Bridges Volume 4, Section 1 Part 2 [online] available at: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol4/section1/hd2208.pdf (last accessed March 2018).
[20] Highways England, Mott MacDonald and Keynetix (2018) HA GDMS Geotechnical Data Management System v5.12.0. [online] available at: http://www.hagdms.com/index.cfm?fuseaction=login.loginform&badLogin=1&CFID=5&CFTOKEN=1A15A0C6-7C96-4ED3-AB95F3F858E318F6 (last accessed July 2018) [log in details required].

  - A Landmark Envirocheck Report.
  - An unexploded ordnance pre-desk study assessment of the route by Zetica.
  - Observations from a site walkover completed by an engineering geologist on 22 and 23 March 2016 are also incorporated into this study.
- A303 Sparkford to Ilchester Dualling Annex A to PSSR produced to be read in conjunction with the PSSR and providing further information regarding the layout of the existing carriageway. This is included as Appendix 9.2, Volume 6.3.

Geological setting

9.7.3 The area is dominated by the east-west trending ridge of Camel Hill formed by the relatively resistant beds of the White Lias and the Blue Lias. Surrounding Camel Hill are the relatively flat, low lying vales of Sparkford and Ilchester.

9.7.4 Geological mapping can be found on Figure 9.1 of Volume 6.2.

Superficial deposits

9.7.5 British Geological Survey (BGS) mapping[21,22] indicates superficial deposits are limited in their distribution across the red line boundary area. Whilst no alluvium is recorded within the red line boundary on the geological map, BGS boreholes record alluvium (as well as Taele Gravel) at approximate chainage 1,200 metres.

9.7.6 A small area of river terrace deposits (sand and gravel) is west of Sparkford on BGS mapping. This is indicated to be present adjacent to the north of the easternmost section of the scheme at the existing dual carriageway alignment (chainage 5,600 - 5,900 metres) and underlies and area within the scheme redline boundary to be used as an ecological mitigation area, as depicted on the Environmental Masterplan (Figure 2.8 of Volume 6.2).

9.7.7 River terrace deposits are also indicated to be present at Podimore, extending some 300 metres to the east of the settlement and south of the existing A303 with some limited areas of head deposits beyond. These deposits are not recorded as being present directly beneath the proposed scheme alignment, but

[21] British Geological Survey (1973) Geological Survey of England and Wales 1:63, 360/1:500,000 geological map series, New Series p(Sheet number 296 – Glastonbury), 1:50,000 scale, Solid and Drift [online] available at: http://www.bgs.ac.uk/data/maps/maps.cfc?method=viewRecord&mapId=10187 (last accessed March 2018).
[22] British Geological Survey (2017) Online viewer – bedrock and superficial geology and borehole search functions [online] available at: http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html (last accessed March 2018)

given the scale of the geological mapping, it is possible they may be encountered during construction.

Solid geology

9.7.8 BGS mapping[23,24], indicates the area is principally underlain by the Langport Member, Blue Lias Formation and the Charmouth Mudstone Formation (undifferentiated), of the Lias Group (previously referred to as the Lower Lias). According to the PSSR (Appendix 9.1, Volume 6.3):

- The Langport Member (previously referred to as the Langport Beds or the White Lias) comprise a series of tough cream and buff calcite mudstones with thin interbedded pale grey and buff marls anticipated to be approximately 6.4 metres in thickness at Sparkford.
- The overlying Blue Lias comprises an interbedded sequence of grey and blue-grey limestones and mudstones / shales. At Camel Hill, the Blue Lias is anticipated to be approximately 7.6 metres in thickness.

9.7.9 The BGS[25] note that much of the Lias has high pyrite and sulphate content and is responsible for high levels of thaumasite concrete attack. Lias clays also contain variable amounts of the clay mineral smectite, and are hence prone to swelling and shrinking. The Lias Group rocks are recorded as having the highest incidence of landsliding in the UK.

9.7.10 In the vicinity of Camel Hill, the existing A303 (and the scheme) is crossed by a small inlier of undifferentiated interbedded mudstone and limestone of the Westbury Formation and the Cotham Member of the Penarth Group (previously known as the Rhaetic Beds). The inlier is bounded to the southern side by an east-west trending normal fault (Camel Hill Fault) which passes beneath both Options, down-throwing the strata to the south by an unspecified amount.

9.7.11 The regional inclination of strata is variable across the scheme, but broadly inclined to the north.

[23] British Geological Survey (1973) Geological Survey of England and Wales 1:63, 360/1:500,000 geological map series, New Series p(Sheet number 296 – Glastonbury), 1:50,000 scale, Solid and Drift [online] available at: http://www.bgs.ac.uk/data/maps/maps.cfc?method=viewRecord&mapId=10187 (last accessed March 2018).
[24] British Geological Survey (2017) Online viewer – bedrock and superficial geology and borehole search functions [online] available at: http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html (last accessed March 2018).
[25] Hobbs, P.R.N., Entwisle, K.L., Northmore, K.J., Sumbler, Metres.G., Jones, L.D., Kemp, S., Self, S., Barron, METRES. and Meakin, J.L (2012) *Engineering Geology of British Rocks and Soils - Lias Group*. British Geological Survey, 323pp. (OR/12/032) (unpublished) [online] available at: http://nora.nerc.ac.uk/17270/ (last accessed March 2018).

Geomorphology

9.7.12 The geomorphology of the region is governed by the underlying geological structure and Quaternary geological history of the area, while slope morphology is determined by the underlying geology and local weathering processes.

9.7.13 Camel Hill is formed by the more resistant beds of the White Lias and Blue Lias. The Lower Lias forms the low-lying vales, where the slope angles are generally less than 3°. Slopes of up to 6° are measured in the transitional Camel Hill side slopes, with a generally concave slope pattern of decreasing slope angles with distance from the ridge.

9.7.14 The White Lias forms the main escarpment of the ridge and slopes are generally 8° or 9°. Back from the escarpment as the sequence moves up into the Blue Lias the slopes on top of Camel Hill are flatter, generally less than 5°. The north face of Camel Hill is formed by the dip slope of the Blue Lias, generally around 8 to 10°.

9.7.15 The east-west trending fault is associated with an elevated area between Plowage and Camel Cross. This has steep slopes on its flanks with a flatter top. According to the PSSR (Appendix 9.1, Volume 6.3), the area is thought to be underlain by a resistant block of Blue Lias strata up-thrown through subsidiary faulting.

Previous ground investigation data

9.7.16 A number of historical GIs have been completed in the area, broadly located along the scheme alignment. These are summarised in Table 9.5.

Table 9.5: Historical GIs

Investigation	Criteria
Department for Transport, 1986	16 cable percussive boreholes relevant to the scheme
Department for Transport, 1994	45 cable percussive boreholes
Department for Transport, 1994	39 rotary boreholes
Department for Transport, 1994	57 trial pits
Mott MacDonald, Supplementary Investigation, 2004	29 trial pits
Mott MacDonald, Supplementary Investigation, 2004	12 cable percussion and rotary core boreholes

Source: A303 Sparkford to Ilchester Dualling PSSR (Appendix 9.1, Volume 6.3)

9.7.17 Plans of existing exploratory locations can be found in the PSSR (Appendix 9.1 PSSR, Volume 6.3).

9.7.18 The relevant exploratory boreholes located along the route of the existing A303 provide information on the local ground conditions as summarised in Table 9.6. However, it should be noted that these are restricted to the westbound

carriageway of the proposed alignment and GI that is currently ongoing would provide confirmation for the eastbound section of the route.

Table 9.6: Baseline data

Chainage	Details
0 - 2,000 metres	Thin layer of topsoil up to 0.5m thick, underlain by firm to very stiff, grey clay. Some layers contain calcareous shells and concretions, occasional thin beds of slightly laminated mudstone (Lias Group).
2,000 – 3,500 metres	Topsoil around 0.3m thick overlying sand and gravel superficial deposits (River Terrace Deposits). Rockhead is recorded at a maximum of 8m below ground level (bgl) with stiff to very hard, grey, silty sometimes shelly clay. The Camel Hill fault crosses the proposed scheme at a chainage of approximately 3,200m with Westbury Formation and Cotham Member limestone beds 100m east of the fault line.
3,500 – 5,000 metres	Thin layer of superficial deposits to a max depth of 1.45m bgl, generally described as brown sand and gravel with Blue Lias Formation (limestone) proven to 15m bgl. To the south of the road up to 1m thick River Terrace Deposits of gravel are recorded.
5,000 – 6,000 metres	Approximately 0.3m thickness of topsoil occasionally underlain by River Terrace Deposits of gravel to a maximum of 0.7m thick. Bedrock comprises Charmouth Mudstone Formation (of Lias Group).

Source: A303 Sparkford to Ilchester Dualling PSSR (Appendix 9.1, Volume 6.3)

9.7.19 The PSSR (Appendix 9.1, Volume 6.3) suggests the following general sequence of deposits in the vicinity of the scheme:

- Topsoil / Made Ground.
- Alluvium / Taele Gravel (presence).
- River Terrace Deposits (near Podimore and Sparkford).
- Lower Lias Clay / Mudstone / Siltstone / Limestone.
- Blue Lias Clay / Mudstone / Limestone (at Camel Hill).
- White Lias Clay / Mudstone / Limestone (at Camel Hill).
- Westbury Formation and Cotham Member Limestone (at Camel Hill).

Current ground investigation data

9.7.20 The GI along the proposed route was completed in June 2018. A copy of the GI location plan and schedule of investigative locations can be found in Appendix 9.3 Volume 6.3.

9.7.21 At the time of writing, the laboratory work was still underway and as such the results not yet available. A number of borehole and trial pits have been completed, these predominantly relate to the area of agricultural land to the west of Hazlegrove Roundabout, with isolated logs available for the south of the proposed route to the west of the B3151 and in fields to the north-east of Plowage Lane.

9.7.22 From the initial data available to date, ground conditions encountered generally comprised silty / sandy / gravelly clay topsoil of 0.15 - 0.4 metre thickness,

occasionally overlying a limited thickness of probable superficial deposits (River Terrace Deposits of gravelly and sandy gravelly clay or Alluvium comprising a gravel of limestone encountered at 2 locations to a maximum of 2.1 metres below ground level).

9.7.23 At some locations Made Ground was encountered to a maximum of 1.2 metres below ground level either below a layer of topsoil or where topsoil was absent, which generally comprised reworked natural materials with the exception of the investigative location to the west of the B3151 which also contained macadam and sub-base, presumably from the construction of the existing A303.

9.7.24 The bedrock geology encountered comprised the Langport Member, Blue Lias and Charmouth Mudstone Formation (undifferentiated) which was encountered below the superficial deposits or Made Ground where present and below topsoil where not, and comprised interbedded silty/sandy/gravelly clays (closer to the surface where weathered), limestones and mudstones.

Coal mining and brine extraction

9.7.25 According to the Coal Authority Interactive Map Viewer[26], historic or current coal mine workings are not present beneath or in the vicinity of the scheme. Brine excavation is not anticipated in the area based on the surrounding geology.

Scheme soils

9.7.26 The MAGIC online map viewer[27] shows a map of the soil types present. Two different soil types are shown along the scheme alignment. At approximately chainage 0 - 2,000 metres the soil is described as slightly acid, loamy and clayey soils with impeded drainage. From approximately chainage 2,000 metres to the east, the soil is described as lime-rich loamy and clayey soils with impeded drainage. The Agricultural Land Classification (ALC) in the vicinity of the scheme is predominantly Grade 3. See Chapter 12 People and Communities of Volume 6.1, for more baseline details on agricultural soils.

Sites of geological significance

9.7.27 There are no geologically designated SSSIs within the vicinity of the scheme.

[26] Coal Authority (2017) Interactive Map Viewer [online] available at: http://mapapps2.bgs.ac.uk/coalauthority/home.html (last accessed March 2018).
[27] Defra (2017) MAGIC Online Map [online] available at: http://magic.defra.gov.uk/ (last accessed March 2018).

Local Geological Sites

9.7.28 There is 1 Local Geological Site (LGS) within 250 metres of the scheme red line boundary, known as Camel Hill Quarry East. Camel Hill Quarry East LGS is located adjacent to the south of the existing A303, immediately adjacent to the scheme red line boundary) (as shown on Figure 9.1 of Volume 6.2). This is described by Somerset Environmental Records Centre (SERC) as “hummocky areas in woods”.

Active building stone site

9.7.29 According to the *Somerset Minerals Plan* (see paragraph 9.3.25), an active building stone site comprising 2.1 hectares in the south-western corner of a 12.9-hectare field is present to the west of Camel Hill Farm, to the immediate north of the proposed route at approximate chainage 3,620-3,700 metres (as shown on Figure 9.1 of Volume 6.2). The mineral is listed as White Lias and the output (including waste stone returned to the site for restoration purposes) is to not exceed 4,000 tonnes of stone. The north of the site is to be crossed by one of the temporary haulage routes.

Mineral Safeguarding Areas

9.7.30 From approximate chainage 2,300 metres the scheme lies within an area designated for building stone safeguarding according to the Somerset Minerals Plan (see paragraph 9.3.25). It describes building stone is an important resource and a key part of the minerals sector in Somerset. Safeguarding Areas are areas of known specific minerals resources designated by the County Council so they are not needlessly sterilised by non-mineral development.

Historical quarries

9.7.31 Historical OS mapping contained within the Landmark Envirocheck Report (appendix B of PSSR, contained in Appendix 9.1, Volume 6.3), details a number of historical quarries located in close proximity to the existing A303 and the proposed scheme alignment in the vicinity of Camel Hill (as shown on Figure 9.1 of Volume 6.2).

9.7.32 One historical quarry is located across the path of the proposed scheme located to the south-west of Camel Hill Cottage at approximate chainage 4,150 metres, with 2 more located immediately to the south of the proposed scheme alignment at approximate chainage 4,200 metres and chainage 4,850 metres. The presence or composition of any backfilled materials is unknown.

9.7.33 A third, located approximately 90 metres to the south of the proposed red line boundary at approximate chainage 100 metres of the proposed local road to the west of Sparkford roundabout has been used for landfilling purposes.

BGS Recorded Mineral Sites

9.7.34 There are a number of BGS Recorded Mineral Sites[28] in close proximity to the current A303 and proposed scheme alignment in the vicinity of Camel Hill. They predominantly relate to Camel Hill Farm and Ridge, Queen Camel for the excavation of Westbury Formation and Cotham Member (limestone) along with Langport Member, Blue Lias Formation and Charmouth Mudstone (limestone). Several of them coincide with the location of historic quarry sites.

Hydrogeology

9.7.35 Aquifer mapping can be seen on Figure 9.1 of Volume 6.2.

Superficial deposits

9.7.36 According to Environment Agency online mapping[29], the overlying drift deposits, where present, are classified as a Secondary A Aquifer. These deposits do not provide any groundwater resource but may contain localised groundwater that could become a consideration in terms of construction, dewatering and impacts on surface water bodies. The groundwater regime will be confirmed on completion of the current GI.

Bedrock

9.7.37 Environment Agency mapping shows that the bedrock geology present across the site (solid strata of the Langport Member, Blue Lias Formation and the Charmouth Mudstone Formation) is classed as a Secondary A Aquifer, defined as the presence of "*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*".

9.7.38 In the vicinity of Camel Hill, the interbedded mudstone and limestone of the Westbury Formation and the Cotham Member of the Penarth Group are classed as Secondary B Aquifers, defined as "*lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering*".

9.7.39 No part of the scheme is located within a Groundwater SPZ, with the nearest Zone 2 (outer zone) located approximately 3.5 kilometres south-east of Sparkford.

9.7.40 According to the Environment Agency, groundwater vulnerability across the greater part of the area is classified as an Intermediate Minor Aquifer. However, there is a lack of abstraction boreholes in the area with only 2 abstraction

[28] British Geological Survey (2017) Mineral resource maps in England and parts of north Wales [online] available at: https://www.bgs.ac.uk/mineralsuk/planning/resource.html (last accessed March 2018).

licences recorded within the Envirocheck Report (appendix B of the PSSR, contained within Appendix 9.1, Volume 6.3) to the west of Sparkford dating back to 1967 - 70.

9.7.41 The area lies within the South West River Basin District (RBD) and is currently classified by the Environment Agency as “not assessed (unproductive strata)” for the purposes of the RBMP.

Previous hydrogeological ground investigation data

9.7.42 Groundwater conditions along the scheme alignment would be influenced by the depth of the Blue Lias Formation and the presence and composition of any overlying superficial deposits.

9.7.43 Site investigation boreholes (supplementary investigation in 2003) as reported within the PSSR (Appendix 9.1, Volume 6.3) close to the existing route of the A303 showed either no shallow groundwater strikes or water strikes in thin limestone interbeds in the Blue Lias Formation between about 2 and 5 metres in depth. With no rise in levels after 20 minutes, large inflows are not expected but heavy rainfall may have an immediate effect. These boreholes were constructed where superficial deposits were virtually absent.

9.7.44 On the southern slopes of Camel Hill, groundwater strikes are at elevations around and above 40 metres above Ordnance Datum (AOD) and reflect groundwater in granular deposits resting on underlying impermeable beds within the Blue Lias Formation. A corresponding series of springs is recorded on the baseline mapping of the area (Figures 9.1 and 9.2, Volume 6.2).

9.7.45 Further boreholes to the west of the route alignment revealed superficial deposits overlying the Blue Lias Formation with water strikes within both superficial gravel deposits and the limestone interbeds within the Blue Lias.

Hydrology

9.7.46 The proposed scheme lies within the catchment of the River Cam to the south and to a more limited extent, the River Cary via Dyke Brook to the north (as shown on Figure 9.1 of Volume 6.2). The River Cam runs approximately 500 metres south of the proposed scheme alignment in a roughly parallel direction to the west before it joins the River Yeo at a confluence near Yeovilton. Dyke Brook ranges from being around 1,200 metres to 1,650 metres north of the proposed scheme alignment where it flows to the west in a roughly parallel direction and meets with the River Cary.

9.7.47 Dyke Brook and the River Cam are fed by a number of springs that can be seen on the OS map of the area. Numerous springs are indicated on site mapping and a number of the fields have linear drainage ditches which appear to flow

southwards. The proposed scheme does not cross any major water courses however there are 8 existing culverts passing beneath the A303. See Appendix 4.3 Road Drainage and the Water Environment Assessment Summary in Volume 6.3 for more information.

Foot and mouth burial sites

9.7.48 As part of the PSSR (Appendix 9.1, Volume 6.3) consultation was undertaken with the Department for Environment Food and Rural Affairs (Defra) regarding the location of foot and mouth burial sites within the scheme area. The State Veterinary Service reported that there were no foot and mouth cases within the district and that the nearest burial site is to the west of Taunton.

Unexploded ordnance

9.7.49 An unexploded ordnance (UXO) pre-desk study assessment of the route by Zetica (contained within appendix C of the PSSR, Appendix 9.1, Volume 6.3) has identified a likely low UXO hazard level.

Control of Major Accidents Hazards Regulations sites

9.7.50 According to the Envirocheck Report (appendix B of the PSSR contained within Appendix 9.1, Volume 6.3) there are no Control of Major Accident Hazards (COMAH) Regulations sites within 500 metres of the scheme.

Ground quality (contaminated land)

Current land use and man-made features

9.7.51 The principal land use surrounding the existing A303 is agriculture including arable farming and pasture for dairy farming.

9.7.52 The principal man-made feature for the scheme is the existing highway network with the towns of Sparkford and Podimore at either end of the proposed scheme and the numerous smaller settlements both to the north and south of the existing A303.

9.7.53 An active filling station is located at approximate chainage 4,700 metres to the immediate south of the scheme red line boundary, while Steart Road Garage with associated underground fuel tanks is located in close proximity to the north of the proposed scheme alignment at chainage 3,300 metres. A filling station is also present south of Hazlegrove Roundabout, to the immediate south-east of the proposed scheme red line boundary.

9.7.54 MOD land (used as a signal station) with a visible array is present immediately to the south of the existing A303 and proposed scheme alignment at approximate chainage 4,250 metres. Adjacent to the MOD site is an

approximately 25 metre-tall communication tower located 30 metres from the edge of the existing A303.

9.7.55 According to the PSSR (Appendix 9.1 of Volume 6.3), Made Ground has been encountered within boreholes along the route alignment to a maximum depth of 1.4 metres below ground level. The material is variable, generally described as sandy clay with fragments of brick, concrete and hardcore. Made Ground is anticipated with the existing road construction, comprising asphalt over Type 1 sub-base.

Scheme area history

9.7.56 The historical development of the area has been summarised from historical mapping contained within the Landmark Envirocheck Report (appendix B of the PSSR contained within Appendix 9.1, Volume 6.3).

9.7.57 Historical mapping shows that the vicinity of the scheme has comprised generally agricultural land, wooded areas and orchards throughout its history and generally runs parallel to the line of historic roads prior to the construction of the existing A303 (around 1979) and junctions including Hazlegrove roundabout to the east.

9.7.58 On the earliest mapping (1886), several quarries were indicated to the north and south of the eastern half of the proposed route. However, the majority of these were no longer marked by 1904 mapping suggesting abandonment or infilling. At this time a saw pit was also indicated to the west of the current Hazlegrove Roundabout on the edge of a wooded area (chainage 5,200 metres). The quarry to the north of Gason Lane was only marked as disused on 1982 mapping suggesting a longer active period.

9.7.59 The filling station to the south of the existing A303 at chainage 4,700 was first marked on 1975 mapping. A garage was also shown to the south of the road at Camel Cross chainage 2,050 metres on 1975 mapping, however the site is now in use as a bed and breakfast and restaurant. The garage at Steart Road was also first indicated on 1975 mapping.

9.7.60 The MOD land (used as a signal station) to the immediate south of the A303 chainage 4,250 metres was first identified on 1962 mapping (although unlabelled, its exact date of construction between 1904 - 1962 is unknown).

9.7.61 Over time, the surrounding settlements have grown and the number of mapped ponds and springs in the vicinity has risen.

Landfill records

9.7.62 Two historical landfills are located within 250 metres of the scheme alignment:

- Land Adjacent to Hazlegrove Park, which accepted inert and household waste from June 1989 to June 1990. The route crosses the southern boundary of the landfill at approximately chainage 5,650 – 5,900 metres, now open farm land.
- Camel Hill Quarry, which accepted inert and industrial waste from 29 November 1989 to 5 June 1992, which is located approximately 90 metres to the south of the scheme red line boundary at the approximate chainage 5,050 metres, now heavily wooded land.

Potential contamination sources

9.7.63 The following points summarise the likely potential contamination sources identified for the scheme alignment:

- Infilled historic quarries containing unknown fill present potential soil and groundwater contamination risks.
- Historical and current fuel stations and garages with underground tanks adjacent to proposed scheme.
- Eastern end of route passes over an existing landfill site referred to as Land Adjacent to Hazlegrove Park and the landfill site known as Camel Hill Quarry is located approximately 90 metres from the red line boundary to the south. Both are potential sources of contaminated soils, landfill leachate and landfill gas.
- Presence of Made Ground originating from the construction of the existing A303 and isolated commercial, residential and agricultural uses.
- Details of the MOD site adjacent to the existing A303 at chainage 4,250 metres are unknown. Hazard signs for asbestos are displayed, possibly forming the roofs of the older buildings on the site.
- Existing highway verges can become contaminated over time through spray and run-off which can contain fuels, oils, heavy metals and other products such as antifreeze.

Baseline receptor summary

9.7.64 From the baseline data above, the receptors that have the potential to be affected by the features identified are summarised within Table 9.7.

Table 9.7: Principal receptors

Receptor	Details
Geology – Mineral Resources	Superficial deposits – Anticipated limited areas of River Terrace Deposits and Alluvium. Mineral resources – Solid geology, predominantly limestone. Within Building Stone Safeguarding Area. Active Building Stone Site to immediate north of proposed permanent development area.
Geology – Local Geological Sites	Camel Hill Quarry East - Present to the immediate south of the existing A303, a heavily wooded former quarry.
Agricultural Soils	Slightly acid, loamy and clayey soils with impeded drainage predominantly ALC Grade 3 land.
Soils – Made Ground	Urban Classified Soils that are physically and chemically suitable for re-use.
Surface Water	Numerous springs, drainage ditches and small surface Water courses, specifically the River Cam to the south and to a more limited extent, the River Cary via Dyke Brook to the north.
Groundwater	• Superficial deposits – Secondary A Aquifer. • Langport Member, Blue Lias Formation and the Charmouth Mudstone Formation - Secondary A Aquifers. • Westbury Formation and the Cotham Member of the Penarth Group - Secondary B Aquifers.
Human Receptors	Users of the future dual carriageway and users of nearby businesses / community properties (predominantly food outlets, hotels, fuel stations and a church) along with residential properties (farms, houses on Plowage Lane, Steart Hill, Howell Hill).
Built environment	Buried services (pipe materials) and construction materials (predominantly concrete).
Site flora (future landscaping and grassed areas)	Future landscaped areas (predominantly new verges and reinstated areas).

9.8 Potential impacts

Construction

9.8.1 The following impacts are predicted for the scheme during construction.

- The Camel Hill Quarry East LGS is located immediately south of the existing A303 and the red line boundary. Construction works would not encroach through boundaries of this site, and therefore there is not considered to be any impacts upon the LGS and it has been scoped out of further assessment below.
- Excavation works associated with the scheme (to a maximum depth of approximately 12 metres) will result in the permanent removal or sterilisation of any areas of Superficial Deposits (and their future use as a potential resource), with the potential for adverse effects. Site construction may also lead to the permanent removal of high quality agricultural soils or topsoil / subsoil material. In addition, soil deterioration and consolidation may occur due to vehicle movements and loading, leading to adverse effects.
- There is potential for the discharge of contaminated or sediment laden groundwater to watercourses following dewatering of excavations or

foundation works. During foundation works, there is the potential for the creation of contamination pathways or driving down of contaminants presenting a risk to groundwater along with the potential for increased turbidity and quality deterioration within the aquifers, which would result in adverse effects.

- Given the nature of their work, construction and maintenance workers may come into contact with potentially contaminated soils, leachates or ground gases particularly in landfill areas, which present the potential for adverse effects.
- The scheme would directly encroach on the southern extent of the historical landfill referred to as Land adjacent to Hazlegrove Park. It is possible for potentially contaminated ground to be directly disturbed during construction, specifically as a result of required earthworks, however, the severity of the contamination would depend on the exact nature of the fill materials. Localised residual contamination from infilled land, existing highway usage, adjacent small scale commercial land uses and agricultural practices may also be encountered.
- Contaminant mobilisation during excavation or remediation activities could potentially cause contamination of soils, groundwater and surface water, particularly in vicinity of historical landfilling and former (potentially infilled) quarries. The contamination of soils, groundwater and surface water could also occur through accidental spills and leaks relating to construction plant and fuels / oils.
- The removal or remediation of any areas of contaminated soils identified would have a potential beneficial effect.

9.9 Design, mitigation and enhancement measures

9.9.1 The scheme has been designed, as far as possible, to minimise effects on geology and soils. Appropriate mitigation options have been identified based on a review of guidance provided in the English Nature Publication[30];in DMRB Volume 11, Section 3 Part 11 *Geology and Soils*[31], and using professional judgement.

[30] English Nature (2006), *Geological conservation – a guide to good practice* [online] available at: http://publications.naturalengland.org.uk/publication/83048 (last accessed March 2018).
[31] Highways England (1993) Design Manual for Roads and Bridges Volume 11 Section 3 Part II *Geology and Soils* [online] available at: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/11s3p11.pdf (last accessed March 2018).

Construction

9.9.2 The following best practice measures would be adopted during the construction stage to minimise effects upon geology, soils and contaminated land.

9.9.3 An ***Outline Environmental Management Plan (OEMP)* (*document reference TR010036/APP/6.7*)** has been produced to support this Development Consent Order (DCO) application and would be developed into a full CEMP by the appointed contractor. The OEMP includes a commitment to prepare a Contaminated Land Risk Assessment (CLRA) and following this a Remediation Strategy (if required); any mitigation as part of this process will be detailed within the CEMP.

Geological resources

9.9.4 Mitigation of effects to directly underlying geological resources as a result of new or modified earthworks is relatively limited, as the geological material must be built over to facilitate the new carriageway alignment.

9.9.5 The alignment of the scheme predominantly along the existing A303 minimises the additional footprint of the works and helps to limit effects on geology at these locations. In addition, the excavation and re-use of site-won materials (both superficial deposits and bedrock) would act to minimise the sterilisation of geological resources (see Chapter 10 Material Assets and Waste, Volume 6.1).

Protection of soil structure and quality

9.9.6 Valuable site topsoil and subsoils would be stripped first, segregated and stockpiled appropriately for reinstatement or re-use across the site. Appropriate procedures would be incorporated into a Soil Management Plan (SMP) within the CEMP. At this stage an outline SMP has been included within Annex B.2 of the ***OEMP* (*document reference TR010036/APP/6.7*)**.

9.9.7 The inclusion of a SMP within the CEMP would ensure works are undertaken in accordance with appropriate guidelines such as Defra's *Code of Practice for the Sustainable Use of Soils on Construction Sites*[32] and BS2882: 2015 particularly in areas where reinstatement of agricultural land would be required temporarily during construction. Mitigation measures within the SMP in addition to topsoil and subsoil stripping and storage include the use of a proprietary geotextile membrane to protect the existing ground condition where haul routes or site compounds / storage areas are located. A layer of inert crushed granular material placed on a geotextile membrane would form temporary running

[32] Defra (2011) *Code of practice for the sustainable use of soils on construction sites* [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69308/pb13298-code-of-practice-090910.pdf (last accessed March 2018) [now withdrawn as of May 2018 but has been referred to in the absence of replacement guidance].

surfaces for construction plant and reinforcement of access tracks. Car parking and pedestrian areas would be bolstered with asphalt surfacing.

9.9.8 Where importation of topsoil is required for spreading on areas of newly constructed earthworks, this would be selected in accordance with BS 3882:2015[33] to ensure that the topsoil provides suitable substrates for native plant species and to maximise biodiversity, in accordance with industry best practice.

Minimisation of waste generation

9.9.9 Where major earthworks are required, a cut and fill balance would be aimed for (further details are available within Chapter 10 Material Assets and Waste, Volume 6.1), however surplus soils may be suitable for re-use elsewhere on the scheme depending on testing of the soils and providing the results fall within defined acceptability criteria.

9.9.10 The scheme would cross a relatively limited area of River Terrace Gravels and potentially Alluvium, although additional un-mapped deposits may be encountered. Therefore, where possible the re-use of excavated Gravels across the site or of excess materials on nearby sites would be promoted to minimise the volume of resource sterilised. Appropriate mass balance calculations, a robust Materials Management Plan (MMP), a Site Waste Management Plan (SWMP) and compliance with the CL:AIRE document *The Definition of Waste: Development Industry Code of Practice*[34] would help to maximise the re-use of suitable geological resources while minimising waste generated.

9.9.11 The earthworks specification would provide geotechnical and chemical acceptability criteria to which site won and imported materials would comply before being used during construction.

Protection of controlled waters: general

9.9.12 Excavated materials would be managed in line with the requirements in the OEMP and eventual CEMP, including (but not limited to) the following measures:

- Stockpiles would be located away from principal surface watercourses given that none are crossed by the proposed scheme and the closest main river is located approximately 500 metres to the south (see Figure 2.9 and Figure 9.1 of Volume 6.2). However, there are a number of minor drainage ditches and culverts crossed by the scheme and the careful

[33] British Standards (2015) BS 3882:2015 *Specification for topsoil*.
[34] CL:AIRE (2011) *The Definition of Waste: Development Industry Code of Practice*. Version 2 [online] available at: http://www.carbonaction2050.com/sites/carbonaction.ciobrebuild.io1dev.com/files/document-attachment/Definition%20of%20Waste.%20Development%20Industry%20Code%20of%20Practice.pdf (last accessed March 2018).

management of construction site drainage would be undertaken, including the use of cut-off ditches to collect site run-off, with run-off passed through settling lagoons or silt traps to allow removal of sediments prior to discharge. Where considered necessary, treatment plant would be made available on site, including:
    - Settlement tanks.
    - Chemical dosing plant (addition of coagulants / flocculants to ensure slow settling solids can be removed).
    - Concrete washwater treatment plant (designed to deal with high pH washwater from concrete construction works).
    - Oil-water separators.
    - Materials separators (to separate and recover sand and gravel).
- Management of excavated topsoil and subsoils would be in line with the guidance provided within the outline SMP (Annex B.3 of the ***OEMP, document reference TR010036/APP/6.9***). There would be clear segregation of materials with dust suppression measures and covers for stockpiles as necessary. Where stockpiles are long term, seeding would be considered to minimise soil being entrained in runoff water and being transported to drainage ditches.
- Works would be monitored by a suitably qualified Site Environmental Clerk of Works, to be responsible in identifying and approving all methods of pollution control.
- An auditing programme would be implemented to verify environmental performance.

9.9.13 During the scheme GI, investigative locations have been located at sites where the potential for the presence of contaminated materials has been identified. This means that suitable controlled waters risk assessment can be undertaken which will identify the appropriate remediation / mitigation measures necessary to minimise the potential environmental risks to sensitive receptors. Remediation / mitigation measures relating to any contamination identified would be implemented through the scheme Remediation Strategy.

Protection of controlled waters: excavation and foundation works

9.9.14 Since construction would be undertaken over a Secondary A and B Aquifer (see Sheet 1 Figure 9.1 of Volume 6.2) there is a risk that excavation and foundation works could create vertical pollution pathways.

9.9.15 Where piling or penetrative ground improvement is required, the works would be carried out in accordance with the Environment Agency guidance[35] [36]. If following the scheme GI, contaminated land is identified in areas of piling or penetrative ground improvement, a foundation works risk assessment would need to be undertaken to determine the likely effects relating to the driving of piles through any contaminated Made Ground or landfilled materials and into the underlying Secondary A Aquifer, and to identify what mitigation measures are appropriate for the site. These would include:

- Selection of pile design to minimise pathway creation at soil-pile interface and appropriate choice of piling method.
- Selection of a suitable class of concrete by qualified geotechnical engineer.
- Use of temporary casing to protect groundwater from contact with grout and fines generated during boring.

9.9.16 The pouring of concrete or use of chemicals could results in the contamination of site soils, and associated pollution entering the underlying Secondary Aquifer or any surface water drains. Therefore, appropriate measures would be included within the Contractor's method statement for the protection of the environment, reflecting guidance in the CEMP, including the batching of concrete only in designated impermeable areas with a segregated drainage system, placement of temporary bunds down-slope to contain any spillages, and the development of a spill response protocol.

9.9.17 The discharge of potentially contaminated groundwater would be appropriately managed by the Contractor through the use of appropriate treatment prior to discharge as discussed previously in paragraph 9.9.15.

Management of construction plant and materials

9.9.18 Working method statements would be in place during construction, reflecting the guidance within the CEMP to ensure environmentally safe working practices on site with respect to the underlying ground and groundwaters. These would include (but not be limited to):

- The storage of oil, fuel and other potentially hazardous substances would be within a secure site compound located on a hardstanding area.

[35] Environment Agency (2001) *Piling and penetrative ground improvement methods on land affected by contamination: guidance on pollution prevention*. National Groundwater and Contaminated Land Centre Report NC/99/72 [online] available at: http://www.merseygateway.co.uk/publicinquirydocs/Core-docs/CD-256.pdf (last accessed March 2018).
[36] Environment Agency (2002) *Piling into contaminated sites. National Groundwater and Contaminated Land Centre Report* [online] available at: http://webarchive.nationalarchives.gov.uk/20140329082414/http://cdn.environment-agency.gov.uk/scho0202bisw-e-e.pdf (last accessed March 2018).

Storage of these substances would be within an appropriately bunded area (110% of total capacity volume).

- There would be a designated refuelling and maintenance area and concrete batching area located on impermeable hardstanding with drainage treated appropriately.
- Regular inspections of site plant would be carried out and the use of drip trays and training in the location and use of spill kits and emergency spillage procedures would be provided for site workers. Action Plans would be in place to effectively deal with any contamination issues during construction for example spillages and leaks from construction plant.
- Wheel washing facilities with a washwater treatment system in place would be utilised to prevent transfer of site soils to adjacent roads and best practice dust suppression methods would be employed on-site to prevent soil erosion.
- Adjacent areas outside the development boundary would be protected by site fencing to prevent accidental encroachment and damage of topsoil.

Excavations and dewatering

9.9.19 Excavations below ground level may require dewatering of runoff waters, perched waters or groundwaters from the Superficial Secondary Aquifer. This water would be appropriately managed on-site through the use of appropriate treatment prior to discharge as discussed previously in paragraph 9.9.15.

9.9.20 Discharge to surface waters would require a Land Drainage Consent from Somerset Drainage Board Consortium.

9.9.21 If contamination is present or suspected on-site treatment or off-site disposal may be required, and would be detailed within the Remediation Strategy.

Management of contamination risks

9.9.22 The PSSR (Appendix 9.1, Volume 6.3) was prepared to inform the design of the intrusive GI.

9.9.23 The detailed intrusive GI is currently underway (the GI location plan and schedule of investigative locations can be found in Appendix 9.3 Volume 6.3) and includes the collection of soil and groundwater samples for laboratory analysis to enable full determination of risks from contamination to human, environmental and structural / utilities receptors along with waste classification.

9.9.24 All investigations of land potentially affected by contamination would be carried out in accordance with established procedures including BS10175 (2011) *Code of Practice for the Investigation of Potentially Contaminated Sites* and CLR11. The framework for the assessment of potential land contamination is included within paragraph 9.3.25.

9.9.25 Central to planning guidance is the requirement that, following development, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of EPA (paragraph 9.3.4). The NPSNN and NPPF also provide guidance on the implementation of contaminated land and pollution management requirements to address contamination risks associated with future site uses.

9.9.26 To achieve this, following the GI a qualitative and quantitative CLRA would be prepared for the scheme during the examination period, prior to commencement of construction. This would inform the conceptual site model and identify any unacceptable contamination risks and enable the selection of appropriate mitigation measures to ensure protection of human and environmental receptors (including controlled waters) during construction. Any mitigation measures required would be incorporated into the CEMP on completion of the CLRA.

9.9.27 The CLRA scope would include (but not be limited to):

- Confirmation of the current geo-environmental baseline for the proposed route including its potentially contaminative history along with geological, hydrogeological and hydrological factors updated with factual site data;
- Assessment of site specific GI chemical testing data using current best practice and standards to accurately determine the potential risks to human health, controlled waters, building materials, vegetation and in relation to ground gas risks given the different options for long term end use; and
- Production of a revised Site Conceptual Model, to be used to determine the potential contaminant linkages present (source-pathway-receptor model).

9.9.28 Following the completion of the CLRA, a Remediation Strategy would be prepared. Prior to the completion of the Remediation Strategy consultation with Environmental Agency and South Somerset District Council would be undertaken.

9.9.29 If areas of contamination are identified (after additional GI is completed, if required), the Remediation Strategy would manage all identified risks and ensure that the scheme does not result in the creation of additional contamination transport pathways. The Remediation Strategy would include (but not be limited to):

- Review contaminated land risk assessment to identify pollutant linkages with unacceptable risks that require mitigation.
- Identifying feasible remediation options for each relevant pollutant linkage.

- Producing a remediation strategy that addresses all relevant pollutant linkages, where appropriate by combining remediation options.

9.9.30 Following on from the Remediation Strategy, the preparation of a site-specific Method Statement for the removal, transportation, deposition and monitoring of any identified contaminated material would be developed by the Contractor if necessary and in line with the Pollution Prevention and Control Regime and the Environmental Permitting Regulations. The Method Statement would be incorporated within the CEMP, where necessary.

9.9.31 The Method Statement would include specific instructions in relation to:

- The control of excavation, separation, handling and storage activities, to ensure that those soils identified as contaminated are not combined with uncontaminated soil.
- The on-site treatment of contaminated material if appropriate to allow re-use as appropriate thereby minimising the amount for offsite disposal.
- The issue of appropriate health and safety procedures when working with contaminated materials.

9.9.32 Due to the nature of their work, construction and maintenance workers are likely to ingest, inhale, or come into dermal contact with any potentially contaminated soils, waters or gases if present. Construction and maintenance workers may also be at risk from exposure to ground gas, particularly when undertaking works in excavations and confined spaces. Risks to construction and maintenance works would be mitigated through risk assessments undertaken by the Contractor specific to the works in order to identify risks and appropriate mitigation measures in line with all relevant health and safety legislation and guidance.

9.9.33 In addition, the following measures would be implemented to mitigate risks associated with contaminated waste:

- It is the responsibility of the producer to ensure that all waste created on site undergoes basic characterisation prior to disposal to an appropriate landfill. To ensure on-site waste management is in line with best practice and the waste hierarchy the following would be implemented:
    - Full characterisation of soil and macadam samples in accordance with the Environment Agency's Guidance on the Classification and Assessment of Waste[37] and determine whether re-use of the soils within the scheme earthworks could be safely achieved.

[37] Environment Agency (2015) *Waste Classification – Guidance on the classification and assessment of waste* (1st Edition): Technical Guidance [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427077/LIT_10121.pdf (last accessed March 2018).

    - Once waste characterisation has been undertaken, the completion of Waste Acceptance Criteria testing (WAC) (where necessary) to establish the acceptability of hazardous, hazardous non-reactive and inert wastes for landfill disposal. Every effort would be made to minimise waste to be landfilled with treatment at an appropriate facility or on-site treatment hub considered in the first instance.
- Hazardous substances such as excavated contaminated land, fuels, chemicals, waste and construction materials would be stored, handled, transported and disposed of in accordance with the CEMP and SWMP.

9.9.34 Similar methodologies would also be employed during the selection of any fill for import. Greater detail in respect of proposed screening and testing of imported materials is provided in Chapter 10 Material Assets and Waste of Volume 6.1.

Works in areas of historical landfills, infilled quarries or Made Ground

9.9.35 Based on assessment of historical mapping, Environment Agency and Local Authority records, it is anticipated that works would be undertaken across a historical landfill and crossing areas of backfilled quarries.

9.9.36 Further GI includes investigation at these locations to accurately determine the extent and nature of contaminated materials within the red line boundary and a quantitative assessment of the associated risks and appropriate mitigation measures necessary. These are likely to include aquifer protection measures such as casing through any backfilled materials, recirculation or safe containment of drilling flush, plugging / reinstatement of landfill linings, appropriate disposal of excavated contaminated materials and reinstatement of capping materials if encountered.

9.9.37 Landfill material, Made Ground and natural strata have the potential to produce ground gases. Ground gas risks would be assessed in accordance with current guidance following GI completion as part of the CLRA process and appropriate mitigation identified.

9.10 Assessment of likely significant effects

9.10.1 This section details an assessment of effects that are applicable to the scheme, which includes a range of construction activities with the potential to result in adverse effects on geology and soils. Principal construction activities of relevance to geology and soils are anticipated to include:

- Excavation works – resulting in the permanent removal of shallow deposits (soils, Made Ground and superficial deposits), potential for contaminated materials to be disturbed.

- Earthworks – resulting in waste generation and disturbance of groundwaters, generation of excavations which will require dewatering, and ground, contamination or landfill gas risks.
- General construction works – the movement of materials, construction plant and storage of materials may lead to compaction of agricultural soils and the storage of hazardous chemicals leading to secondary effects on soils and groundwater.
- Foundation works – piling or penetrative ground improvement as part of foundation construction may pose risks to controlled waters along with environmental risks relating to the use of concrete in construction.

9.10.2 Using Table 9.1, each principal receptor identified has been assigned a sensitivity, with reasoning as provided within Table 9.8.

Table 9.8: Sensitivity of principal receptors

Receptor	Receptor sensitivity	Reasoning
Geology – Superficial Deposits of resource value	Low	According to BGS mapping, superficial deposits are present to the far east (River Terrace Deposits). However, intrusive GI has shown generally limited thicknesses to be present along the route. Anticipated limited areas of River Terrace Deposits and Alluvium.
Geology – LGSs	Medium	Camel Hill Quarry East - Present to the immediate south of the existing A303, a heavily wooded former quarry.
Geology – Mineral Resources	Medium	Mineral resources – Solid geology, predominantly limestone. Within Building Stone Safeguarding Area. Active Building Stone Site to immediate north of proposed permanent development area.
Soils - Natural	Medium	Slightly acid, loamy and clayey soils with impeded drainage predominantly ALC Grade 3 land.
Soils – Made Ground	Negligible	Urban Classified Soils that are physically and chemically suitable for re-use.
Surface Water	Medium	Numerous springs, drainage ditches and small surface Water courses are present in the vicinity, specifically the River Cam to the south and to a more limited extent, the River Cary via Dyke Brook to the north. The River Cam is classed as a Main River while Dyke Brook is understood to be an Ordinary Watercourse.
Groundwater	Medium	• Superficial deposits – Secondary A Aquifer. • Langport Member, Blue Lias Formation and the Charmouth Mudstone Formation - Secondary A Aquifers. • Westbury Formation and the Cotham Member of the Penarth Group - Secondary B Aquifers.
Human Receptors	Low	Highway development is considered to be a low sensitivity land use.
Built environment	Low	Final end use is of low sensitivity (infrastructure).
Site flora (future landscaping and grassed areas)	Low	Future landscaped areas will require regular maintenance and will have generally low ecological value.

9.10.3 Table 9.9 summarises the scheme assessment of construction effects, detailing the potential effect identified and appropriate mitigation measure for a particular receptor. The receptor sensitivity and magnitude of impact has been estimated followed by the identification of the significance category after mitigation (as detailed in section 9.9).

Table 9.9: Assessment of likely significant effects

Receptor	Summary of effects	Mitigation measures (further details contained in section 9.9, sub-heading as listed)	Action by	Receptor sensitivity	Magnitude	Significance category (with mitigation)
Geology	Permanent removal / sterilisation of Superficial Deposits (Alluvium and River Terrace Deposits along with potential unmapped deposits) (and their future use as a potential resource during site construction).	• Geological Resources • Minimisation of waste generation.	Contractor	Medium	Minor (minor permanent impact on geological conditions. Sterilisation of <15% of mineral asset.)	Slight Adverse
	Permanent removal / sterilisation of bedrock (limestones) within Mineral Safeguarding Area.	• Geological Resources • Minimisation of waste generation.	Contractor	Medium	Minor (minor permanent impact on geological conditions. Sterilisation of <15% of mineral asset. Camel Hill Active Building Stone Site lies outside permanent development area).	Slight Adverse
	Impacts on Local Geological Sites – specifically Camel Hill Quarry (Ch. 4950m).	None required as not located within red line boundary. Potential for enhancement measures (see Section 9.9).	Contractor	Medium	Negligible (outside red line boundary)	Neutral
	Formation of new cutting exposures (increasing the area of available geological outcrop for study).	None required.	Contractor	Medium	Minor (minor permanent impact on geological conditions)	Slight Beneficial
Geology/ Soils	Excess material to be generated requiring off-site disposal / transport and re-use with associated waste/carbon generation impacts.	• Minimisation of waste generation.	Contractor	Medium	Moderate (generation of material for off-site disposal)	Slight Adverse
Soils	Permanent removal of high quality site soils during site construction.	• Minimisation of waste generation. • Protection of soil structure and quality	Contractor	Medium	Moderate (removal of a moderate area of soils)	Slight Adverse
	Soil deterioration and consolidation may occur due to poor storage and handling or due to vehicle movements and loading.					

Receptor	Summary of effects	Mitigation measures (further details contained in section 9.9, sub-heading as listed)	Action by	Receptor sensitivity	Magnitude	Significance category (with mitigation)
	Removal / remediation of any areas of contaminated soils identified.	• Management of contamination risks.	Designer (GI) and Contractor	Negligible	Minor (remediation / improvement of a minor area of soil)	Slight Beneficial
Surface Water	Surface water runoff to become entrained with sediment and pollute nearby watercourses.	• CEMP. • Protection of controlled waters: general. • Excavations and dewatering. • Management of contamination risks. • Protection of controlled waters: foundation works. • Works in areas of historic landfills, infilled quarries or made ground.	Contractor	Medium	Moderate (worst case) (dependent on extent of pollution and change in chemical quality - EQSs)	Slight Adverse
	Discharge of potentially contaminated / sediment laden groundwater to watercourses following dewatering of excavations/foundation works.					
	Concrete spillages entering local drainage ditches.					
Groundwater	Creation of contamination pathways/driving down of contaminants during GI / foundation works, presenting a risk to groundwater.		Designer (GI) and Contractor	Medium	Moderate (worst case) (dependent on extent of pollution and change in chemical quality - DWSs)	Slight Adverse
	Increased turbidity within the aquifer due to GI / foundation construction operations.					
	Injection of grouts or pastes into groundwater during foundation works potentially leading to quality deterioration.					
Human receptors	Contact of construction and maintenance workers with potentially contaminated soils, leachates or ground gases.	• Management of contamination risks.	Contractor	Medium	Moderate (at worst) (dependent on characteristics of contamination and exposure period)	Neutral
	Effects on final end users are considered to be very limited given the nature of the proposed use as a highway.		Designer (GI) and Contractor	Low	Negligible (no anticipated measurable impact)	Neutral

Receptor	Summary of effects	Mitigation measures (further details contained in section 9.9, sub-heading as listed)	Action by	Receptor sensitivity	Magnitude	Significance category (with mitigation)
Buildings, structures and utilities	Degradation of construction materials, for example concrete and pipe materials. Concrete elements of the scheme are considered to be vulnerable as much of the underlying Lias has high pyrite and sulphate content and is responsible for high levels of thaumasite concrete attack.	• Management of contamination risks.	Designer	Low	Moderate (worst case) (depending on exact chemical conditions encountered)	Neutral
Flora	Impairment of landscape and grassland re-development. While the linear areas to be re-vegetated after construction are considered to be of low ecological potential, if the soil chemical composition is not suitable for vegetation establishment the strips of land may be left vulnerable to erosion.	• Protection of soil structure and quality. • Management of contamination risks.	Contractor	Low	Moderate (worst case) (depending on extent of damage to soil structure and chemical composition)	Slight Adverse
Multiple (contamination related)	Contamination of soils, groundwater and surface water through contaminant / landfill gas mobilisation during excavation or remediation activities, particularly in vicinity of historic landfills and former (potentially infilled) quarries, specifically: • Landfill: Land adjacent to Hazlegrove Park approximate Ch. 5650-5900m. • Filling station at approximate Ch. 4700m and adjacent to Hazlegrove Roundabout, garage at chainage 3,300m. • MOD land at approximate chainage 4250m.	• CEMP. • Protection of soil structure and quality. • Dust suppression. • Protection of controlled waters. • Excavations and dewatering. • Management of contamination risks. • Works in areas of historic landfills, infilled quarries or Made Ground.	Contractor	Medium	Moderate (worst case) (depending on specific site activities and nature of landfilled materials / Made Ground)	Slight Adverse

Receptor	Summary of effects	Mitigation measures (further details contained in section 9.9, sub-heading as listed)	Action by	Receptor sensitivity	Magnitude	Significance category (with mitigation)
	• Made Ground and potential contaminated natural ground from existing highway construction and use.					
	Generation of waste contaminated soils. Contamination of soils, groundwater and surface water through accidental spills and leaks relating to construction plant and fuels / oils.					

9.10.4 Incorporating the mitigation measures as outlined in section 9.9, the maximum residual effect identified is Slight Adverse. Therefore, no effects are considered to be significant.

9.11 Monitoring

9.11.1 An on balance Slight Adverse effect has been identified to geology and soils during construction, meaning that there would be no significant effects and therefore no requirement for long-term monitoring of adverse effects.

9.11.2 However, the scheme alignment passes over an area of historical landfill to the far east, north of Hazlegrove Roundabout. Therefore, it is recommended that leachate and ground gas monitoring around the landfill be undertaken prior to, during and post construction to establish a baseline against which to monitor any changes in surrounding groundwater quality and the gassing regime from the construction works.

9.11.3 Monitoring requirements would be included within the Remediation Strategy reporting for the site.

9.11.4 With respect to soil reinstatement, monitoring and aftercare requirements are confirmed within the outline SMP (Annex B.3 of the ***OEMP, document reference TR010036/APP/6.9*****)** and include:

- Continuing communication with the landowner;
- A before and after survey of levels to ensure correct drainage and soil depths; and
- Cropping as soon as possible with a crop that has a good rooting system (grass or cereals). This will help minimise soil slumping and erosion in the event of heavy rainfall.

9.12 Conclusions

9.12.1 In summary, the geology and soils assessment has shown that with the inclusion of appropriate mitigation measures as outlined in section 9.9, construction stage effects on identified receptors are not considered to be significant, with an on-balance construction stage effect anticipated to be Slight Adverse at worst.

9.12.2 Mitigation measures have been outlined within section 9.9 and within the ***OEMP*** **(*document reference TR010036/APP/6.7*).** However, as detailed above, the completion of the intrusive targeted GI, qualitative and quantitative CLRA and Remediation Strategy (if required) is necessary to fully develop site specific measures to manage contamination risks. Any additional mitigation requirements identified from the production of the CLRA and Remediation Strategy will be included within the subsequent CEMP.

9.12.3 The completed and operational scheme is not expected to result in any significant adverse effects on geology or soils.

9.12.4 The evidence provided in the ES supports the accordance statement provided in the ***Case for the Scheme (document reference TR010036/APP/7.1*)**.