M5 Junction 10 Improvements Scheme

Preliminary Environmental Information Report (PEIR)

Geology and Soils chapter

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Document accessibility

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Glossary

Term	Description
AADT	Annual Average Daily Traffic
AAWT	Annual Average Weekday Traffic
AEP	Annual Exceedance Probability
ALC	Agricultural Land Classification
AMP	Archaeological Management Plan
AONB	Area of Outstanding Natural Building
ARN	Affected Road Network
ASPT	Average Score Per Taxon
AQAL	Air Quality Assessment Level
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
BAP	Biodiversity Action Plan
BCT	Bat Conservation Trust
BEIS	Department of Business, Energy and Industrial Strategy
BGS	British Geological Survey
BMV	Best and Most Versatile
BoQ	Bill of Quantities
BS	British Standards
BTO	British Trust for Ornithology
CAMS	Catchment Abstraction Management Strategy
CBC	Cheltenham Borough Council
CBC	Common Birds Census
CCC	Committee on Climate Change
CD&E	construction, Demolition and Excavation
CEMP	Construction Environmental Management Plan
CEA	Cumulative Effects Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CIRIA	Construction Industry Research and Information Association
CL:AIRE	Contaminated Land: Applications in Real Environments
CLP	Classification, Labelling and Packaging
CMS	Continuous Monitoring Station
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COP	Conference of the Parties
COSHH	Control of Substances Hazardous to Health
CPS	Connecting Places Strategies
CRoW	Countryside and Rights of Way
CRTN	Calculation of Road Traffic Noise
CSZs	Core Sustenance Zones
DCO	Development Consent Order
DfT	Department for Transport
DM	Do Minimum
DMOY	Do Minimum Scenario in the Opening Year
DMFY	Do Minimum Scenario in the Future Assessment Year
DMRB	Design Manual for Roads and Bridges
DoE	Department of the Environment
DoWCoP	Definition of Waste: Development Industry Code of Practice
DS	Do Something
DSFY	Do Something in the Future Assessment Year
DSOY	Do Something Scenario in the Opening Year
EC	European Commission
ECoW	Ecological Clerk of Works
eDNA	environmental DNA

Term	Description
EEA	European Economic Area
EFT	Emissions Factors Toolkit
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
END	Environmental Noise Directive
EPA	Environmental Protection Act
EPS	European Protected Species
EPUK	Environmental Protection UK
EQS	Environmental Quality Standards
EU	European Union
ES	Environmental Statement
FRA	Flood Risk Assessment
ES	Environmental Statement
GCC	Gloucester City Council
GCER	Gloucestershire Centre for Environmental Records
GCN	Great Crested Newt
GFirst LEP	Gloucestershire Local Enterprise Partnership
GHER	Gloucestershire Historic Environment Record
GHGs	Greenhouse Gases
GLNP	Gloucestershire Local Nature Partnership
GLVIA3	Guidelines for Landscape and Visual Impact Assessment
GLTA	Ground Level Tree Assessment
GPLC	Guiding Principles for Land Contamination
GWDTE	Groundwater Dependant Terrestrial Ecosystems
GWT	Gloucestershire Wildlife Trust
HDV	Heavy Duty Vehicles
HER	Historic Environment Record
HEWRAT	Highways England Water Risk Assessment Tool
HGVs	High Good Vehicles
HIF	Housing Infrastructure Fund
HLC	Historic Landscape Characterisation
HMC	Habitat Modification Class
HMS	Habitat Modification Score
HRA	Habitat Regulations Assessments
HSI	Habitat Suitability Index
IAQM	Institute of Air Quality Management
IDB	International Drainage Board
IPCC	International Panel on Climate Change
JCS	Joint Core Strategy
JNCC	Joint Nature Conservation Committee
LAQM	Local Air Quality Management
LCAs	Landscape Character Assessments
LCRM	Land Contamination: Risk Management
LCT	Landscape Character Type
LDV	Light Duty Vehicles
LLFA	Lead Local Flood Authority
LNR	Local Nature Reserves
LOAEL	Lowest observed adverse effect level
LTP	Local Transport Plans
LVIA	Landscape and Visual Impact Assessment
MAFF	Ministry of Agriculture, Fisheries and Food
MCHW	Manual of Contract Documents for Highway Works
MHCLG	Ministry of Housing, Communities and Local Government
MMP	Materials Management Plan
MSA	Mineral Safeguarding Areas
MW	Minor Watercourse

Term	Description
NCA	National Character Area
NERC	Natural Environment and Rural Communities
NHLE	National Heritage List for England
NIAs	Noise Important Areas
NMP	National Mapping Programme
NMU	Non- Motorised User
NNR	National Nature Reserves
NPS NN	National Policy Statement for National Networks
NOEL	No Observed Effect Level
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NPSE	Noise Policy Statement for England
NSIP	Nationally Significant Infrastructure Projects
NSR	Noise Sensitive Receptors
NVC	National Vegetation Classification
OS	Ordnance Survey
PAH	Polyaromatic Hydrocarbons
PAS	Portable Antiquities Scheme
PCBs	Polychlorinated Biphenyls
PCF	Project Control Framework
PCL	Potential Contaminant Linkage
PCM	Pollution Climate Mapping
PCSM	Preliminary Conceptual Site Model
PEAOR	Preliminary Environmental Assessment of Options Report
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PPE	Personal Protective Equipment
PPGs	Pollution Prevention Guidelines
PPG	Planning Practice Guidance
PPS10	Planning Policy Statement 10
PPGN	Planning Practice Guidance: Noise
PRA	Preliminary Roost Assessment
PRoW	Public Right of Way
Q_{95}	The 5 percentile flow
RAMS	Risk Assessments, Method Statements
RBD	River Basin Districts
RBMP	River Basin Management Plans
RCP	Relative Concentration Pathway
RCS	River Corridor Survey
RFFPs	Reasonably Foreseeable Future Projects
RHS	River Habitat Survey
RNAG	Reason for not Achieving Good
RoWIP	Rights of Way Improvement Plan
SAC	Special Area of Conservation
SHMP	Soil Handling Management Plan
SM	Scheduled Monument
SOAEL	Significant Observed Adverse Effect Level
SoCC	Statement of Community Consultation
SPD	Supplementary Planning Document
SPA	Special Protection Area
SPZ	Source Protection Zones
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
SWMP	Site Waste Management Plan
TAMP	Transport Asset Management Plan
TBC	Tewkesbury Borough Council

Term	Description
TAR	Technical Appraisal Report
TSCS	Thin Surface Course System
UKCP18	United Kingdom Climate Projections 2018
UNFCCC	United Nations Framework Convention on Climate Change
UXO	Unexploded Ordnance
VfM	Value for Money
WCH	Walkers, Cyclists and Horse Riders
WEEE	Waste Electrical and Electronic Equipment
WER	Water Environment Regulations
WFD	Water Framework Directive
WHTP	Whalley, Hawkes, Paisley & Trigg
WSI	Written Scheme of Investigation
ZTV	Zone of Theoretical Visibility

Chapters 1-4 of this PEIR have been produced as a separate document.

1. Introduction

2. The Scheme

3. Assessment of Alternatives

4. Environmental Assessment Methodology

Table 4-1 - Significance Matrix

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

Table Source: DMRB LA 104 Environmental assessment and monitoring Table 3.8.1

Table 4-2 - Significance categories and typical descriptions

Value	Typical descriptors
Very Large	Effects at this level are material in the decision-making process.
Large	Effects at this level are likely to be material in the decision-making process.
Moderate	Effects at this level can be considered to be material decision-making factors.
Slight	Effects at this level are not material in the decision-making process.
Negligible	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Table Source: DMRB LA 104 Environmental assessment and monitoring Table 3.7

The discipline specific chapters of this PEIR have been produced as separate documents.

5. Air Quality

6. Noise and Vibration

7. Biodiversity

8. Road Drainage and the Water Environment

9. Landscape and Visual

10. Geology and Soils

10.1. Introduction

10.1.1. This chapter presents the preliminary environmental assessment of the M5 Junction 10 Improvements Scheme (the Scheme) for Geology and Soils based on the Scheme as it is described in Chapter 2 (and detailed in the Design Fix 2 drawings in Appendix 2.1). This chapter identifies the geology and soil study area, sets out the assessment methodologies, presents the baseline conditions and describes the likely impacts and effects. Design and mitigation measures which can be used to mitigate potential impacts are also provided.

10.1.2. This chapter assesses the following topics in accordance with the methodology set out in the DMRB series of LA guidance documents, in particular LA104: Environmental assessment and monitoring (DMRB, 2019) and LA109: Geology and Soils (DMRB, 2019):

- Effects on bedrock geology and superficial deposits, including geological designations and sensitive/valuable non-designated features;
- Effects on agricultural land, including Best and Most Versatile (BMV) agricultural land and on soil resources; and
- Effects from contamination on human health, surface water and groundwater.

10.1.3. On the basis that Environmental Protection Areas (Ramsar sites, Local Nature Reserves, non-designated notable habitats, EU designated sites etc) in which the supporting soils could be directly affected were not present within the study area, these were scoped out of the assessment at the scoping stage (Atkins, 2020). Geological features of local, regional, national or international importance were also scoped out of the assessment for the same reason.

10.1.4. Mineral deposits as a resource, and waste generated by the Scheme are topics discussed in Chapter 12 (Materials and Waste). Effects associated with water quality are provided in Chapter 8 (Road Drainage and the Water Environment) and effects associated with landform are reported in Chapter 9 (Landscape). Impacts on commercial farming activities are discussed in Chapter 13 (Population and Human Health).

10.2. Planning policy and topic legislative context

10.2.1. This geology and soils assessment has been undertaken in accordance with the following policy, legislation and guidance.

National Policy and Legislation

National Policy Statement for National Networks 2014

10.2.2. The Scheme falls within the definition of an NSIP under the NPS NN (Department of Transport, 2014), making the NPS NN the primary planning policy against which an application for a DCO for the Scheme would be judged.

10.2.3. Paragraph 5.22 of the NPS NN relates to sites of geological importance and states that where the project is subject to EIA the applicant should ensure that the ES clearly sets out any likely significant effects on internationally, nationally and locally designated sites of ecological or geological conservation importance.

10.2.4. Furthermore, paragraph 5.25 states that development should avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives.

10.2.5. Paragraph 5.168 of the NPS NN relates to soils resources and land contamination and states that applicants should take into account the benefits of BMV agricultural land. Where significant development of agricultural land is demonstrated to be necessary, applicants should seek to use areas of poorer quality land in preference to that of a higher quality. Applicants should also identify any effects, and seek to minimise impacts on soil

quality, taking into account any mitigation measures proposed. Where possible, developments should be on previously developed (brownfield) sites. For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination.

10.2.6. Paragraph 5.179 also states that applicants should minimise the direct effects of a project by the application of good design principles, including the layout of the project and the protection of soils during construction.

National Planning Policy Framework 2021

10.2.7. Paragraph 174 of the NPPF (Ministry of Housing, Communities and Local Government, 2021) is of particular relevance to geological and soil conservation, stating that policies and decisions should contribute to and enhance the natural and local environment by 'protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan)' as well as recognising the 'economic and other benefits of the BMV agricultural land, and of trees and woodland.'

10.2.8. Paragraph 174 also states that plans should prevent new and existing development from contributing to, being put at an unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. 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 higher quality.

10.2.9. Paragraph 183 states that policies and decisions should ensure that a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination.

10.2.10. Building on the NPPF, Planning Practice Guidance (PPG) published in 2014 provides the guiding principles on how planning can deal with contaminated land.

Environmental Protection Act 1990

10.2.11. Part 2A of the Environmental Protection Act (EPA) 1990 (United Kingdom Government, 1990) introduced a statutory regime for the identification and remediation of 'Contaminated Land'. It provides a statutory definition of 'Contaminated Land' based on significant harm or the likelihood of significant harm or significant pollution or significant possibility of such pollution of controlled waters (all groundwater, inland waters and estuaries, excluding water perched above the zone of saturation).

10.2.12. Local authorities are the primary regulators under the Part 2A regime, with a duty to identify whether the land in their area is 'Contaminated Land', although provision is made for consultation and co-ordination with the Environment Agency in situations when pollution of controlled waters is an issue.

Contaminated Land Statutory Guidance 2012

10.2.13. The principal objectives of the legislation are described in the DEFRA's Contaminated Land Statutory Guidance 2012 (DEFRA, 2012), as follows:

- Identify and remove unacceptable risks to human health and the environment;
- Seek to ensure that contaminated land is made suitable for its current use; and
- Ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development.

10.2.14. These three objectives underlie the 'suitable for use' approach to the assessment and remediation of 'land contamination'. This approach recognises that the risks presented by any given level of land contamination will vary greatly according to the use of the land and a wide range of other factors, such as the sensitivity of the underlying geology and the receptors which may be affected. The 'suitable for use' approach consists of three elements:

- Ensuring that land is suitable for its current use;
- Ensuring that land is made suitable for any new use; and
- Limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land.

The Water Resources Act 1991 (as amended)

10.2.15. The Water Resources Act (United Kingdom Govenment Legislation, 1991) sets controls of pollution of water sources in Section III. It contains information about water quality objectives, powers to prevent and control pollution, and pollution offences.

Water Framework Directive 2015

10.2.16. The purpose of the WFD (DEFRA, 2015) as enacted by the Water Resources (Water Framework Directive) (England and Wales) Regulations (United Kingdom Government, 2017), is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. It requires that:

- Environmental objectives should be set to ensure that good status of groundwater is achieved and that its deterioration is avoided. This includes that any upward sustaining trend in the concentration of a pollutant must be identified and reversed;
- A good status of groundwater requires early action and stable long-term planning of protective measures, owing to the natural time lag in its formation and renewal; and
- Monitoring programmes should cover monitoring of the chemical and quantitative status of groundwater.

River Basin Management Plan 2015

10.2.17. The RBMP (Environment Agency, 2015) is designed to protect and improve the quality of the water environment. It includes consideration of the following topics:

- Plans for the protection and improvement of the water environment;
- Future plans that may affect the infrastructure sector and its obligations;
- Development proposal considerations regarding the requirements of the RBMP; and
- Environmental permit applications.

DEFRA's Safeguarding our Soils – A Strategy for England 2009

10.2.18. Safeguarding our Soils – A Strategy for England (DEFRA, 2009) states that by 2030, DEFRA's vision is that all of England's soils will be managed sustainably and degradation threats are tackled successfully. Chapter 6 of the strategy states objectives for effective soil protection during construction and development are to:

- Ensure soil ecosystems services are fully valued in the planning process;
- Ensure appropriate consideration is given to the protection of good quality agricultural soils from development; and
- Encourage better management of soils through all stages of the construction process.

Local Policy

Joint Core Strategy (JCS) 2011-2031

10.2.19. The key policies of the Joint Core Strategy (Gloucester City, Cheltenham Borough and Tewkesbury Borough Council, 2017) relevant to geology and soils are:

- Policy SD9: Biodiversity and Geodiversity: The purpose of the policy is to ensure that individual assets and the quality of the natural environment in the future is

planned, protected and enhanced at a strategic scale, recognising that networks extend across local authority boundaries. Harm to the biodiversity or geodiversity of an undesignated site or asset should be avoided where possible. Where there is a risk of harm as a consequence of development, this should be mitigated by integrating enhancements into the Scheme that are appropriate to the location.'

- Policy SD14: Health and Environmental Quality: A new development must consider the quality and versatility of any agricultural land affected by proposals, recognising that the best agricultural land is a finite resource.

Guidance Documents

10.2.20. The following guidance documents have been considered:

- British Standards (BS) BS8485+A1:2019 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (British Standards, 2015);
- BS5930+A1:2020 – Code of practice for ground investigations (British Standards, 2015);
- BS10175:2011+A2:2017 – Code of Practice for Investigation of Potentially Contaminated Sites (British Standards, 2017);
- Construction Industry Research and Information Association (CIRIA) C681 Unexploded Ordnance (UXO) – A Guide for the Construction Industry (CIRIA, 2009);
- CIRIA C733 Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks (CIRIA , 2014);
- CIRIA C682 The Volatile Organic Contaminants Handbook (CIRIA , 2009);
- CIRIA C552 Contaminated Land Risk Assessment – A Guide to Good Practice (CIRIA, 2001);
- CIRIA C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings (CIRIA , 2007);
- Contaminated Land: Applications in Real Environments – The Definition of Waste: Development Industry Code of Practice (DoWCoP) (CL:AIRE, 2011);
- DEFRA's Code of Practice for the Sustainable Use of Soils on Construction Sites (DEFRA, 2009a);
- DEFRA's Safeguarding our Soils – A Strategy for England (DEFRA, 2009);
- Department of the Environment (DoE) Industry Profiles for previously developed land, Environment Agency (Environment Agency, 1995);
- DMRB LA 104 Environmental Assessment and Monitoring (DMRB, 2019);
- DMRB, LA 109 Geology and Soils (DMRB, 2019);
- DMRB, LA 113 Road Drainage and the Water Environment (DMRB, 2020);
- Environment Agency Report R&D66 (Environment Agency and NHBC, 2008);
- Guiding Principles for Land Contamination (GPLC) (Environment Agency, 2010);
- Land Contamination: Risk Management (LCRM) (Environment Agency, 2021); and
- Natural England's Technical Information Note 049 Agricultural Land Classification: protecting the best and most versatile agricultural land (TIN049) (Natural England, 2012).

10.3. Methodology

Study Area

Agricultural Land and Soil

10.3.1. The study area for the agricultural land and soil assessment is land likely to be required permanently for the Scheme, including associated embankment and slip-roads and small

areas (i.e. on new roundabouts) where the land can no longer be utilised as a resource. Areas that will be required for attenuation basins, flood compensation areas or temporary works have not been finalised and may be subject to change. Therefore, the impacts outlined in this chapter in relation to these areas will be refined at a later stage of the EIA.

Land Contamination

10.3.2. To consider the effects associated with land contamination, the study area will include the Scheme and land immediately beyond it to a distance of 500m (study area). This is considered appropriate for identifying historical and current potentially contaminative land uses, which may have resulted in contamination within the Scheme, and the location of sensitive off-site receptors, which may be affected by the Scheme.

Assessment Methodology

Agricultural Land and Soil

10.3.3. The assessment has been undertaken in accordance with the methodology set out in the DMRB guidance documents LA104 (DMRB, 2019) and LA109 (DMRB, 2019).

10.3.4. The information in Table 10-1 below is taken from Table 3.11 of LA109 and describes how value (sensitivity) has been assigned. Agricultural land is assigned a value based on its Agricultural Land Classification (ALC) Grade in the application of the Ministry of Agriculture, Fisheries and Food (MAFF) revised guidelines and criteria for grading the quality of agricultural land (MAFF, 1988). BMV agricultural land is land that has been assigned Grade 1, Grade 2 or Subgrade 3a in the ALC system.

10.3.5. Section 3.6.1 of LA109 states that a soil resource and/or ALC survey should be undertaken to inform the assessment where data is incomplete. An ALC survey was carried out in December 2020 along the proposed link road between the A4019 and B4634 and the results used to inform this assessment. The ALC survey results are provided in Appendix 10.4.

10.3.6. DMRB guidance on assigning receptor value states soils which support areas of recognised environmental/ecological interest should also be considered. These receptors were scoped out at the previous stage of assessment (Atkins, 2020). Soils not within BMV agricultural land, nor within an area of recognised environmental/ecological interest, can be allocated a sensitivity value where particular agricultural practices contribute to the quality and character of the environment or local economy. The site visit carried out for the ALC survey confirmed that this exception is not applicable to the study area and has also been scoped out of the assessment.

Table 10-1 - Assigning receptor value (sensitivity) for agricultural land and soil

Receptor value (sensitivity)	Description
Very high	Land in ALC Grades 1 & 2.
High	ALC Subgrade 3a.
Medium	ALC Subgrade 3b.
Low	ALC Grades 4 & 5.
Negligible	Previously developed land formerly in hard uses with little potential to return to agriculture.

Table Source: DMRB LA109 – Geology and soils, Table 3.11.

10.3.7. Table 10-2 is a replication of Table 3.12 and Table E/2.1 of DMRB LA109 and describes how magnitude is assigned to impacts.

Table 10-2 - Magnitude of impact (sensitivity) for agricultural land and soil

Magnitude of impact	Typical description
Major	Physical removal or permanent sealing of soil resource or >20 ha of agricultural land.
Moderate	Physical removal or permanent sealing of 1ha – 20 ha of agricultural land. Permanent loss/reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource.)
Minor	Temporary loss/reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource.)
Negligible	No discernible loss/reduction of soil function(s) that restrict current or approved future use or permanent sealing of <1 ha.
No change	No loss/reduction of soil function(s) that restrict current or approved future use.

Table Source: DMRB LA109 – Geology and soils, Table 3.12 and Table E/2.1.

10.3.8. The significance of effect is determined using the significance matrix in DMRB LA104 (Table 3.8.1), which is displayed in Table 4-1 of this PEIR. Due to the nature of impacts to agricultural land as described above, all effects identified with reference to Table 4-1 (if not neutral) are adverse.

10.3.9. The following influential factors are considered in the agricultural land and soil assessment:

- The assessment of the significance of residual effects considers the implementation of plausible mitigation measures.
- In alignment with DMRB guidance, where two potential values of significance of effect are identified using the matrix in Table 4-1, professional judgement is used to assign the value based on understanding of details of both the magnitude of impact and value of the receptor. For example, where a minor impact is identified in relation to a receptor of high sensitivity, professional judgement is used to determine whether this results in a slight or moderate effect.
- In general, moderate to very large effects are considered significant in terms of the EIA regulations.

Land Contamination

10.3.10. The land contamination assessment has been undertaken using the methodology below and has been informed by the Preliminary Conceptual Site Model (PCSM) developed for the Scheme.

10.3.11. A sensitivity/value has been assigned to each receptor using the criteria detailed in Table 10-3 below. For human health receptors, DMRB guidance document LA 109 (DMRB, 2019) has been used to define the receptor value. To assess surface water and groundwater receptors, DMRB guidance document LA 113 (DMRB, 2020) for road drainage and the water environment has been applied.

Table 10-3 - Assigning receptor value (sensitivity) – land contamination

Receptor Value (Sensitivity)	Description
Human Health	
Very High	Very high sensitivity land use such as residential or allotments.
High	High sensitivity land use such as public open space.
Medium	Medium sensitivity land use such as commercial or industrial.

Receptor Value (Sensitivity)	Description
Low	Low sensitivity land use such as highways and rail.
Negligible	Undeveloped surplus land / no sensitive land use proposed.
Groundwater	
Very High	Principal aquifer providing a regionally important resource and/or supporting a site protected under EC and UK legislation LA 108 (DMRB, 2020). Groundwater locally supports GWDTE. SPZ 1.
High	Principal aquifer providing locally important resource or supporting a river ecosystem. Groundwater supports a GWDTE. SPZ 2.
Medium	Aquifer providing water for agricultural or industrial use with limited connection to surface water. SPZ 3.
Low	Unproductive strata.
Negligible	N/A
Surface Water	
Very High	Watercourse having a WFD classification shown in a RBMP and Q95 ≥ 1.0 m^3/s. Site protected/designated under European Commission (EC) or UK legislation (SAC, SPA, SSSI, Ramsar site, salmonid water) / Species protected by EC legislation LA 108 (DMRB, 2020).
High	Watercourse having a WFD classification shown in a RBMP and Q95 <1.0 m^3/s. Species protected under EC or UK legislation LA 108 (DMRB, 2020).
Medium	Watercourses not having a WFD classification shown in a RBMP and Q95 >0.001 m^3/s.
Low	Watercourses not having a WFD classification shown in a RBMP and Q95 ≤0.001 m^3/s.
Negligible	N/A

10.3.12. Following determination of the value/sensitivity of the receptors, the magnitude of potential impacts has been determined. The criteria for the assessment of impact magnitude is set out in Table 10-4 below.

Table 10-4 - Assigning magnitude of impact – land contamination

Magnitude of Impact (change)	Description
Human Health	
Major	Significant contamination identified. Contamination levels significantly exceed background levels and relevant screening criteria with potential for significant harm to human health. Contamination heavily restricts future use of land.
Moderate	Contaminant concentrations exceed background levels and are in line with limits of relevant screening criteria. Significant

Magnitude of Impact (change)	Description
	contamination can be present. Control / remediation measures are required to reduce risks to human health / make land suitable for intended use.
Minor	Contaminant concentrations are below relevant screening. Significant contamination is unlikely with a low risk to human health. Best practice measures can be required to minimise risks to human health.
Negligible	Contaminant concentrations substantially below levels outlined in relevant screening criteria. No requirement for control measures to reduce risks to human health / make land suitable for intended use.
No change	Reported contaminant concentrations below background levels.
Groundwater	
Major adverse	• Loss of, or extensive change to, an aquifer. • Loss of regionally important water supply. • Potential high risk of pollution to groundwater from routine runoff - risk score >250 (groundwater quality and runoff assessment). • Calculated risk of pollution from spillages ≥2% annually (spillage assessment). • Loss of, or extensive change to GWDTE or baseflow contribution to protected surface water bodies. • Reduction in water body WFD classification. • Loss or significant damage to major structures through subsidence or similar effects.
Moderate adverse	• Partial loss or change to an aquifer. • Degradation of regionally important public water supply or loss of significant commercial/ industrial/ agricultural supplies. • Potential medium risk of pollution to groundwater from routine runoff - risk score 150-250. • Calculated risk of pollution from spillages ≥1% annually and <2% annually. • Partial loss of the integrity of GWDTE. • Contribution to reduction in water body WFD classification. • Damage to major structures through subsidence or similar effects or loss of minor structures.
Minor adverse	• Potential low risk of pollution to groundwater from routine runoff - risk score <150. • Calculated risk of pollution from spillages ≥0.5% annually and <1% annually. • Minor effects on an aquifer, GWDTEs, abstractions and structures.
Negligible	• No measurable impact upon an aquifer and/or groundwater receptors and risk of pollution from spillages <0.5%.
Minor beneficial	• Calculated reduction in existing spillage risk by 50% or more to an aquifer (when existing spillage risk <1% annually). • Reduction of groundwater hazards to existing structures.

Magnitude of Impact (change)	Description
	• Reductions in waterlogging and groundwater flooding.
Moderate beneficial	• Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually). • Contribution to improvement in water body WFD classification. • Improvement in water body Catchment Abstraction Management Strategy (CAMS) (or equivalent) classification. • Support to significant improvements in damaged GWDTE.
Major beneficial	• Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring. • Recharge of an aquifer. • Improvement in water body WFD classification.
No change	• No loss or alteration of characteristics, features or elements; no observable impact in either direction.
Surface Water	
Major adverse	• Failure of both acute-soluble and chronic-sediment related pollutants in the HEWRAT and compliance failure with EQS values. • Calculated risk of pollution from a spillage ≥2% annually (spillage assessment). • Loss or extensive change to a fishery. • Loss of regionally important public water supply. • Loss or extensive change to a designated nature conservation site. • Reduction in water body WFD classification.
Moderate adverse	• Failure of both acute-soluble and chronic-sediment related pollutants in HEWRAT but compliance with EQS values. • Calculated risk of pollution from spillages ≥1% annually and <2% annually. • Partial loss in productivity of a fishery. • Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies. • Contribution to reduction in water body WFD classification.
Minor adverse	• Failure of either acute soluble or chronic sediment related pollutants in HEWRAT. • Calculated risk of pollution from spillages ≥0.5% annually and <1% annually. • Minor effects on water supplies.
Negligible	• No risk identified by HEWRAT (pass both acute-soluble and chronic-sediment related pollutants). • Risk of pollution from spillages <0.5%.
Minor beneficial	• HEWRAT assessment of either acute soluble or chronic-sediment related pollutants becomes pass from an existing site where the baseline was a fair condition. • Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually).

Magnitude of Impact (change)	Description
Moderate beneficial	• HEWRAT assessment of both acute-soluble and chronic-sediment related pollutants becomes pass from an existing site where the baseline was a fair condition. • Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually). • Contribution to improvement in water body WFD classification.
Major beneficial	• Removal of existing polluting discharge or removing the likelihood of polluting discharges occurring to a watercourse. • Improvement in water body WFD classification.
No change	• No loss or alteration of characteristics, features or elements; no observable impact in either direction.

10.3.13. The overall significance of land contamination effects is defined using the matrix presented in Table 10-5, as per LA 104 (DMRB, 2019), which describes the relationship between the value/sensitivity of the receptor and the magnitude (change) of the impact.

Table 10-5 - Assigning significance of effect – land contamination

Value/ sensitivity	Magnitude of impact (degree of change)				
	No change	Negligible	Minor	Moderate	Major
Very high	Neutral	Slight	Moderate or large	Large or very large	Very large
High	Neutral	Slight	Slight or moderate	Moderate or large	Large or very large
Medium	Neutral	Neutral or slight	Slight	Moderate	Moderate or large
Low	Neutral	Neutral or slight	Neutral or slight	Slight	Slight or moderate
Negligible	Neutral	Neutral	Neutral or slight	Neutral or slight	Slight

10.3.14. In alignment with DMRB guidance, where two potential values of significance of effect are identified using the matrix in Table 10-5, professional judgement has been used to assign the value based on understanding of details of both the magnitude of impact and value of the receptor. For example, where a minor impact is identified in relation to a receptor of high sensitivity, professional judgement has been used to determine whether this results in a slight or moderate effect.

10.3.15. Following the classification of an effect, a clear statement is made as to whether the effect is 'significant' or 'not significant'. As a general rule, moderate to very large effects are considered to be significant.

10.4. Consultation

Agricultural Land and Soil

10.4.1. It is stated in the Scoping Report (Atkins, 2020) that consultation will be carried out in accordance with DMRB guidance and TIN049 (Natural England, 2012). However, the Scheme is classified as a Nationally Significant Infrastructure Project (NSIP) and therefore, Natural England, as a consultation body, has been contacted by the Planning

Inspectorate as part of the Application Scoping Request process. Informal consultation has been undertaken with farmers in advance of the ALC survey.

Land Contamination

10.4.2. As part of the EIA, consultation will be undertaken with the Local Authority Contaminated Land Officer and Environment Agency as required.

10.5. Baseline conditions

10.5.1. This section provides a summary of the baseline soil and geology characteristics for the Scheme.

10.5.2. Baseline data has been obtained from publicly available sources including:

- M5 Junction 10 Improvements Scheme. Preliminary Sources Study Report (PSSR), July 2020 (Atkins, 2020);
- West Cheltenham Link Road Agricultural Land Classification Survey Report, completed December 2020 (Appendix 10.4);
- British Geological Survey (BGS) GeoIndex Onshore (British Geological Survey, 2021);
- MAGIC mapping database (DEFRA, 2021);
- Google Earth Satellite imagery;
- Envirocheck reports (Landmark Information Group, 2019); and
- Zetica online Unexploded Ordnance (UXO) risk maps (Zetica, 2021).

Historical Development

10.5.3. The historical development of the study area has been determined using historical ordnance survey maps obtained as part of the Envirocheck reports (Landmark Information Group, 2019).

10.5.4. In 1884 the study area was predominantly undeveloped agricultural land with several farms. Several roads are mapped within the study area including the current Withybridge Lane within the west of the study area and the current B4634 road is within the Scheme in the south of the study area. The current A4019 road is located within the Scheme and passes through the village of Uckington towards Cheltenham located within the east of the study area. A corn mill is shown approximately 190 m west of the Scheme at Withy Bridge.

10.5.5. The River Chelt crosses the Scheme approximately 280 m west of Withybridge Lane. Leigh Brook crosses the Scheme approximately 460 m to the north of the current M5 Junction 10.

10.5.6. In 1885 a smithy is shown approximately 250 m east of the Scheme, to the north of Arle. A sewage farm (Cheltenham Corporation) is shown on 1903 mapping within the north west of the study area located to the west of Barn Farm, approximately 260 m west of the Scheme.

10.5.7. In 1954 mapping engineering works have been constructed approximately 250 m north east of the Scheme to the north of Arle. By 1968 the engineering works have expanded and further residential development within Cheltenham located within the south east of the study area has taken place.

10.5.8. By 1973 the current M5 has been constructed within the Scheme boundary. In 1975 mapping, a works building is located approximate 265 m south east of the Scheme in Cheltenham. Allotment gardens are shown within the south east of the study area located approximately 400 m south east of the current B4634 in Cheltenham. By 1991 further residential development and allotments are shown in the south east of the study area in Cheltenham.

10.5.9. In 2000 the Gallagher Retail Park is shown within the south east of the study area in Cheltenham. The Gallagher Retail Park is located adjacent to the north of the Scheme.

Geology

10.5.10. The BGS GeoIndex (British Geological Survey, 2021) indicates that there are two areas of mapped artificial ground present within the study area. Artificial ground is located in the north of the study area, approximately 200 m north of the Scheme adjacent to the M5 associated with the historical Colman Farm landfill. An area of worked ground (void) associated with an unspecified man-made excavation is also present in the south east of the study area adjacent to the A4019 (underlying the Gallagher Retail Park), approximately 30 m north east of the Scheme.

10.5.11. Although not indicated on published maps, Made Ground is also likely to be present surrounding the existing road networks, associated with its construction and operation.

10.5.12. Superficial deposits of Cheltenham Sand and Gravel and Alluvium are present along the alignment of the existing watercourses, sections of the M5 and the A4019 between the M5 Junction 10 and Cheltenham.

10.5.13. Charmouth Mudstone bedrock underlies the Scheme across the majority of the study area with the Rugby Limestone Member present in the south west of the study area.

Mining Activity and Quarrying

10.5.14. The study area is not located within an area affected by coal mining (Landmark Information Group, 2019).

10.5.15. Two areas licenced for mineral extraction are recorded adjacent to the A4019 approximately 100 m and 220 m north east of the Scheme, with the area mapped in closest proximity likely to be the worked ground (void) indicated by BGS mapping (Landmark Information Group, 2019).

Soil Data

10.5.16. The only published soil map for the study area is the 1:250,000 scale National Soil Map of England and Wales, Sheet 5, South West England (Soil Survey of England and Wales, 1983), which illustrates the soil associations present in the region.

10.5.17. The map displays soils of the Badsey 2 association present on the Cheltenham Sand and Gravel Deposit, consisting of mainly well drained loamy soils. Soils on the Alluvium of the River Chelt are mapped as poorly drained, clayey soils of the Fladbury 1 association. The soils of the Charmouth Mudstone Formation are mapped as the Evesham 2 association of slowly permeable and seasonally waterlogged calcareous clay soils.

10.5.18. The profiles encountered in the December 2020 ALC survey (see Appendix 10.4) reflect the published soil map. The Badsey series, slightly calcareous sandy clay loams with little gleying encountered above 40cm, was present in the northern extent of the ALC survey area. Progressing south, from the Cheltenham Sand and Gravel Deposit and onto the River Chelt Alluvium, the profiles were stoneless, non-calcareous, gleyed clay soils of the Fladbury series. Due to restricted land access, the extent of the Fladbury series could not be confirmed. On the southern extent of the survey study area, the Evesham series of stoneless, slightly calcareous, gleyed clay soils was encountered.

Agricultural Land Classification

10.5.19. As summarised in section 10.3.4, the quality of agricultural land is assessed using the MAFF guidance on ALC (MAFF, 1988). The grading system ranges from Grades 1-5 (1 being the highest quality), with Grade 3 being divided into Subgrades 3a and 3b. ALC Grades 1 and 2 and Subgrade 3a are BMV agricultural land. Figure 10-1 displays the ALC grades assigned to land within the vicinity. The ALC grades and the sources of information are described below.

10.5.20. The findings of the December 2020 ALC survey confirm the predictions made in the Scoping Report (Atkins, 2020). Land provisionally assigned Grade 3 on the 1:250,000 Provisional ALC Map (L. Edwards, 2017) which overlays the Cheltenham Sand and Gravel Deposit is of BMV agricultural land (Subgrade 3a), whilst land directly on Alluvium or Charmouth Mudstone Formation is non BMV agricultural land (Subgrade 3b).

10.5.21. For land parcels within the extent of the proposed link road, where access was not permitted during the December 2020 ALC survey or have been added to the study area since then, the ALC grades have been predicted using a combination of the available information and observations made during the survey.

10.5.22. There are some existing surveys of the wider study area post-1988 which have been used to inform the ALC. Information from previous surveys is available for land located to the west of the M5, but not including the north-west quadrant of Junction 10. Approximately 15 ha of Subgrade 3a (BMV) was identified, immediately south-west of Junction 10. The profiles of the survey points within this area described the absence of gleying, therefore it is expected to be an area of better drainage. Elsewhere to the west of the M5, on the Alluvium of the River Chelt and the Charmouth Mudstone, the land is Subgrade 3b (ADAS, 1994).

10.5.23. An ALC survey was completed in 2009 to inform the EIA for the proposed Elms Park development. Information has been obtained from this 2009 survey (White Peak Planning, 2012) to inform ALC grades on land at the far eastern extent of the Scheme. A section of the road for the Elms Park development has been incorporated into the Scheme since Scoping Stage. BMV agricultural land has been mapped on land north of the road, with a mixture of Grade 2 and Subgrade 3a. Land-take requirements within this section are anticipated to be limited (a 0.5 ha attenuation basin adjacent to the fire station and a small amount of land-take south of the A4019). This area has not been surveyed, but is anticipated to be of BMV agricultural land, on the basis of the adjacent Elm Park ALC survey findings.

10.5.24. The majority of the agricultural land impacted by the Scheme is dominated by Subgrade 3a (BMV land and has a high receptor value) with the remainder as Subgrade 3b (non-BMV land with a moderate receptor value).

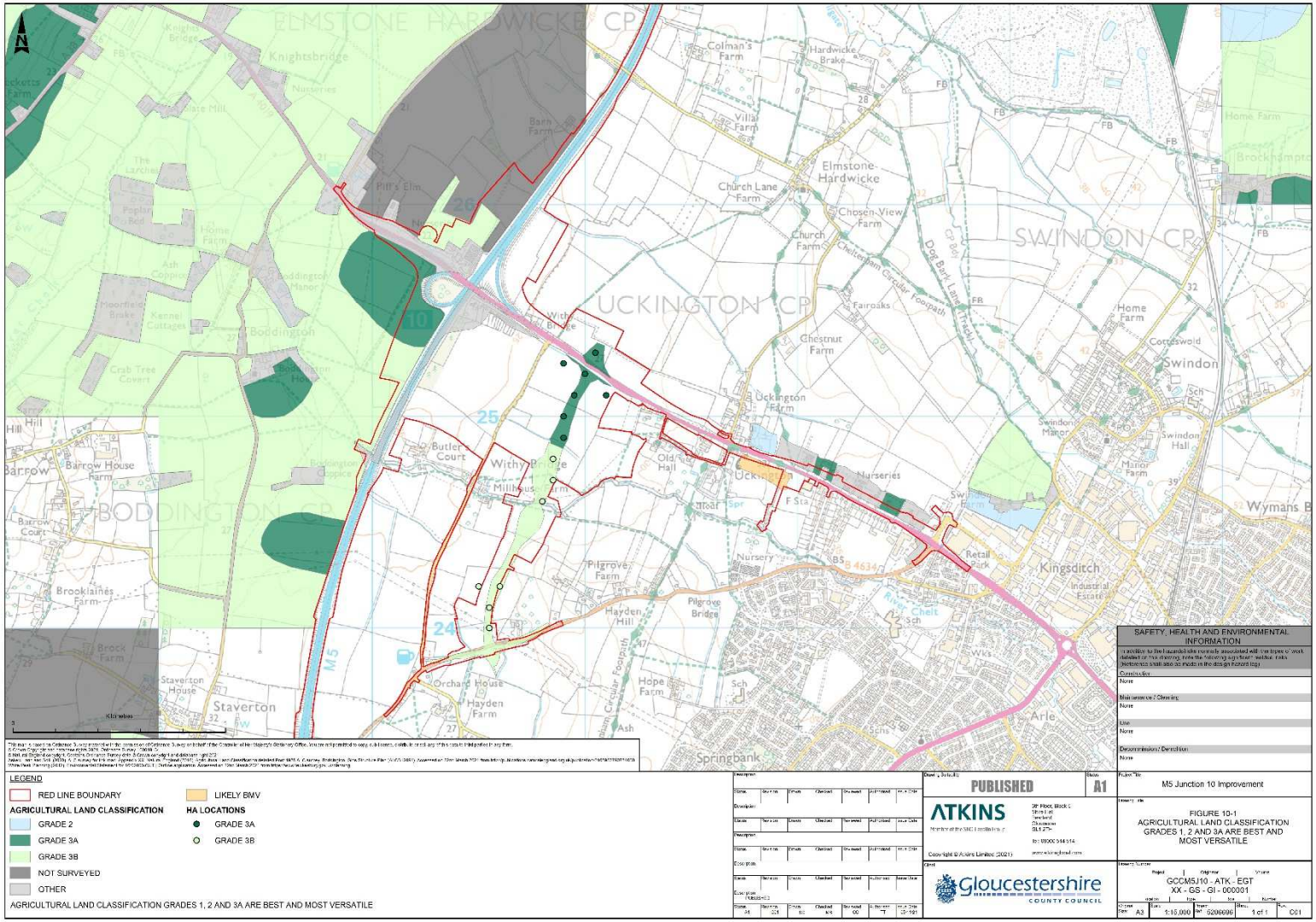

Figure 10-1 - The Agricultural Land Classification grades assigned

Designated Sites

10.5.25. There are no EU designated sites, UK designated sites (e.g. SPA, Ramsar) or non-statutory designated sites (e.g. Local Geological Sites, Local Nature Reserves) present within the soils and agricultural land study area, where sensitive soils could be directly affected and have therefore been scoped out of the assessment.

10.5.26. Areas of Deciduous Woodland are present around Junction 10 which are designated as Priority Habitats/National Forest Inventory sites. However, the soils within these areas are not considered to be significantly or uniquely important to support these habitats and have been scoped out from the geology and soils assessment. The impact to the Deciduous Woodland areas from a biodiversity perspective is described in Chapter 7 (Biodiversity).

10.5.27. The DEFRA MAGIC map application (DEFRA, 2021) indicates that there are no statutory environmental designations within the study area. However, the Scheme is located within the non-statutory Gloucestershire Green Belt (Tewkesbury district) (Gloucester City, Cheltenham Borough and Tewkesbury Borough Council, 2017).

Hydrogeology

10.5.28. The superficial Alluvium and Cheltenham Sand and Gravel strata are classified as high vulnerability, secondary A aquifers. The bedrock Charmouth Mudstone Formation is classified as a medium vulnerability secondary undifferentiated aquifer (unproductive) and the Rugby Limestone Member as a high vulnerability secondary A aquifer (DEFRA, 2021).

10.5.29. The study area is not located within a SPZ. There are no licenced groundwater abstractions within the Scheme or study area (Landmark Information Group, 2019). Tewkesbury District Council was contacted to determine if private water abstractions, where less than 20 m^3 is abstracted per day, are present within the study area. The council responded to confirm that, according to their records, no private local groundwater abstractions are located in the study area.

Hydrology

10.5.30. Two main rivers intersect the study area, the River Chelt to the south of M5 Junction 10 and Leigh Brook to the north. Both rivers flow in a westerly direction joining the River Severn approximately 5.3 km west of the study area. There are no licensed surface water abstractions within the Scheme or study area (Landmark Information Group, 2019). Tewkesbury District Council have confirmed that it has no records of private unlicenced surface water abstractions in the study area.

Flood Risk

10.5.31. The study area has been identified as being at high risk from flooding activities, with the area to the south of M5 Junction 10 surrounding the River Chelt known to be a historical River Severn flood plain with recorded flood events.

10.5.32. Environment Agency mapping (Environment Agency, 2021) indicates the study area to be at risk of flooding by rivers or sea with the land surrounding the River Chelt designated as a Flood Zone 2 (0.1-1% chance of flooding within any given year) and Flood Zone 3 (>1% chance of flooding within any given year) areas. Further information on surface water flooding is described in Chapter 8 (Road Drainage and the Water Environment).

10.5.33. BGS flood risk data indicates that the fields either side of the M5 and A4019 carriageways, and the northern half of the proposed link road, are liable to potential flooding from high groundwater levels.

Contaminated Land

Landfills and Waste Management Sites

10.5.34. There are two historical landfill sites (Landmark Information Group, 2019) located within the study area at the following locations:

- Approximately 200 m north of the Scheme adjacent to the M5 northbound carriageway (Colman's Farm landfill). The site was licensed between 31 July 1970

and 2 September 1972 and accepted household waste. The landfill also accepted excavated natural material, soil and sub-soil waste from 1st May 1992. No end date for this record is provided; however, the licence is listed as 'known to be surrendered'. Colemans Farm Borrow Pit at the same location was licensed between 30 June 1992 to 31 December 1992 and accepted inert, industrial, commercial and household waste; and

- Approximately 30 m north east of the Scheme adjacent to the A4019 (Violet Villa, likely to be the worked ground (void) indicated by BGS mapping). The site accepted inert waste and liquid sludge from 30 September 1967 with no closure date provided.

10.5.35. Elicot Ltd located 340 m north west of the A4019 (west of the M5 Junction 10) at Piffs Elm, holds licenced records as a waste management facility for household, commercial and industrial waste transfer, as well as being a registered waste incineration disposal site.

Fuel Stations

10.5.36. The Envirocheck Report (Landmark Information Group, 2019) indicates that there are two fuel stations located within the study area. The Sainsburys petrol station located 200 m north of the Scheme in the Gallagher Retail Park and the Cheltenham Filling Station (currently Applegreen Cheltenham) located 360 m south east of the Scheme, adjacent to the A4019.

Pollution Incidents

10.5.37. Data indicates there have been nine recorded pollution incidents to controlled waters within the study area. A summary of these incidents is provided below:

- An incident was recorded in 1995 at a dairy cattle farm located adjacent to the west of the M5 carriageway related to a Category 3 minor incident for the release of cattle slurry into an unknown water course;
- In 1995, a Category 3 minor incident was recorded east of the M5 carriageway, located off Withybridge lane for the spillage of oils;
- A Category 3 minor incident located 95 m north east of the A4019 was recorded in 1995 relating to the spillage of oils into an unknown water body;
- In 1996, a Category 3 minor incident was recorded adjacent to Homecroft Drive, 320 m south of the A4019 related to an 'unknown' pollutant affecting the River Chelt;
- In 1998, a Category 3 minor release of oils was recorded on the carriageway of the A4019 at Uckington;
- A Category 3 minor incident was recorded in 1998 relating to the presence of two drums (possibly oil) in the River Chelt, 320 m south of the A4019 near Appleyard Close;
- In 1998 a Category 3 minor incident was recorded 345 m east of Withybridge for the accidental spillage of sewage sludge into the River Chelt;
- A Category 3 minor incident was recorded in 1998 relating to the spillage of heavy-duty heat oil into the Wymans Brook, 463 m north east of the A4019 within the Kingsditch trading estate; and
- An incident was recorded near Mill House, Boddington in 1999, 445 m east of the M5 carriageway related to a Category 3 minor incident for the release of laundry type discharge into the River Chelt.

Unexploded Ordnance

10.5.38. The Zetica online map (Zetica, 2021) indicates that the study area has a low risk encountering UXO. A low risk is defined by Zetica as having '1 bomb impacts per acre or less'.

Preliminary Conceptual Site Model

10.5.39. A PCSM has been prepared for the Scheme. The PCSM identifies the potential or known sources of contamination, receptors and pathways between the two. Where all three are present or are considered likely to be present (source-pathway-receptor linkage), they are called a potential contaminant linkage (PCL).

10.5.40. A summary of potential contamination sources is provided in Table 10-6. Potential pathways and receptors including receptor value identified is provided in Table 10-7. Definitions for the classification of probability and consequence in relation to contamination are provided in Appendix 10.1. The PCSM and risk assessment are provided in Appendix 10.2, , based on guidance in CIRIA C552 Contaminated land risk assessment: a guide to good practice (CIRIA, 2001). Note that this is not an impact assessment..

10.5.41. The PCSMs included in Appendix 10.2 have been used to inform the impact assessment.

Potential Sources of Contamination

Table 10-6 - Potential contamination sources

Potential source of contamination	Contaminants of concern	Location
Made Ground associated with the construction of existing (M5, A4019 and B4634) and proposed carriageways and activities associated with their operation.	A range of inorganic and organic contaminants within Made Ground including asbestos. Fuels and oils attributed to spills from vehicles on the roads included within the Scheme boundary, plus exhaust particulates.	Within the Scheme boundary (on-site)
Agricultural activities.	Contamination risk from herbicides, pesticides, silage, effluent, and fuel oils. Risk of inorganic and organic contamination including ammonia, nitrates, metals and hydrocarbons, polychlorinated biphenyls (PCBs), asbestos, etc.	On-site
Made Ground associated with the construction and operation of adjacent roads.	A range of inorganic and organic contaminants including heavy metals, hydrocarbons and polyaromatic hydrocarbons (PAHs) and the potential for asbestos. Fuels and oils attributed to spills from vehicles on the roads, plus exhaust particulates.	Within the Study Area (off-site)
Historical sewage works / farm (Cheltenham Corporation). 260 m west.	Potential contamination may comprise metals, inorganic contaminants, fuels and oils, PCBs, treatment chemicals, and a potential for hazard gas generation from sludges (as well as sanitary waste).	Off-site
Allotments and agricultural activities within the surrounding area.	Contamination risk from herbicides, pesticides, silage, effluent, and fuel oils. Risk of inorganic and organic contamination including metals and hydrocarbons, asbestos, etc.	Off-site
Historical corn mill 190 m west.	Range of inorganic and organic contaminants including metals and hydrocarbons.	Off-site
Historical smithy 250 m east.	Range of inorganic and organic contaminants including metals and hydrocarbons.	Off-site

Potential source of contamination	Contaminants of concern	Location
Historical engineering works 260 m south east.	Range of inorganic and organic contaminants including metals, petroleum, petrol additives, diesel, oils and lubricants.	Off-site
Sainsburys petrol station 200 m north and the Cheltenham Filling Station 360 m south east.	A range of contaminants including heavy metals, hydrocarbons and PAHs.	Off-site
Violet Villa historical landfill 30 m north east and Colman Farm historical landfill 200 m north.	Range of inorganic and organic contaminants including metals, hydrocarbons, PAHs, PCBs, asbestos and ground gases.	Off-site
Waste management facility 340 m north west of the A4019.	Range of inorganic and organic contaminants including metals, hydrocarbons, PAHs, PCBs, asbestos.	Off-site

Potential Receptors and Pathways

Table 10-7 - Potential receptors, receptor value and exposure pathways

Receptor Group	Receptor	Receptor Value (sensitivity)	Principal Contaminant Migration Pathways
Human Health (on-site)	Construction and maintenance workers of current roads	Medium (commercial/industrial use with potential for contact with soils)	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts, and water; and Inhalation of soil-derived dust, fibres, gas, and vapours.
	Pedestrians accessing existing roads, footpaths, and public rights of way	Low (transient users unlikely to contact soils due to hardstanding)	
	Current road users	Low (transient users unlikely to contact soils due to hardstanding)	
	Users of the new road Scheme	Low (transient users unlikely to contact soils due to hardstanding)	
	Farmers and workers on agricultural land	Medium (commercial/industrial use with potential for contact with soils)	
Human Health (off-site)	Residents in adjacent properties	Very high (residential users in close proximity with potential for long term dust inhalation)	Dermal contact with and ingestion of contaminants in soil-derived dusts and water that may have migrated off-site; and

Receptor Group	Receptor	Receptor Value (sensitivity)	Principal Contaminant Migration Pathways
			Inhalation of soil-derived dust, fibres, gas, and vapours which may have migrated off-site.
	Users of adjacent commercial / industrial premises	Medium (commercial/industrial users with short duration exposure)	
	Pedestrians accessing surrounding roads, footpaths, and public rights of way	Low (sort term transient use)	
	Farmers and workers on agricultural land	Medium (commercial/industrial users with short duration exposure)	
Controlled Waters: Groundwater (on-site and off-site)	Groundwater in Secondary A superficial aquifers (Alluvium and Cheltenham Sand and Gravel)	Medium (moderate productivity aquifer)	Leaching of contaminants in soil to groundwater in underlying aquifers; and Migration of contaminated water through preferential pathways such as underground services, pipes, and granular material to groundwater in underlying aquifers.
	Groundwater in Secondary A bedrock aquifer (Rugby Limestone Formation)	Medium (moderate productivity aquifer)	
	Groundwater in Secondary bedrock undifferentiated aquifer (Charmouth Mudstone Formation)	Low (low productivity strata)	
Controlled Waters: Surface waters (on-site)	River Chelt, Leigh Brook and surface water drains	High (WFD watercourse with a Q95 <1.0 m^3/s)	Lateral migration of contaminated groundwater with discharge to surface watercourses; and Discharge of contaminants entrained in groundwater and, or surface water run-off followed by overland flow and discharge.
Controlled Waters: Surface waters (off-site)	River Chelt, Leigh Brook and surface water drains	High (WFD watercourse with a Q95 <1.0 m^3/s)	Lateral migration of contaminated groundwater with discharge to surface

Receptor Group	Receptor	Receptor Value (sensitivity)	Principal Contaminant Migration Pathways
			watercourses as base flow; and Discharge of contaminants entrained in groundwater and/or surface water run-off followed by overland flow and discharge.

10.6. Potential impacts

Construction

Agricultural Land and Soil

10.6.1. The potential impacts of the Scheme on agricultural land during construction are considered to be:

- The physical removal of agricultural land where land is permanently required for the road and attenuation basins (major magnitude of impact);
- The permanent restriction to future use of agricultural land due to flood compensation areas (moderate magnitude of impact); and
- The temporary loss or the restriction to current agricultural land, due to land temporarily acquired during construction, to be returned to agricultural use (minor magnitude of impact).

10.6.2. The likely extent of potential impacts have been estimated using the current boundary of the Scheme and are presented in Table 10-8. Much of the land uses associated with temporary works are within areas of the Scheme boundary that are proposed as flood compensation areas.

Table 10-8 - Potential impacts to agricultural land and soil

Subgrade sensitivity	Permanent land-take (ha) (major)	Permanent restriction (ha) (moderate)	Temporary land take (ha) (minor)
Subgrade 3a (high sensitivity)	4	35	6
Subgrade 3b (medium sensitivity)	4	20	-

Land Contamination

10.6.3. The land contamination assessment has been completed based on the relationship between the value/sensitivity of the receptor and the magnitude of the impact in accordance with DMRB guidance documents LA109 (DMRB, 2019), LA113 (DMRB, 2020). The PCSMs included in Appendix 10.2 have been used to inform the potential magnitude of the impact.

10.6.4. Construction activities could potentially introduce new sources of contamination (i.e. from spillages and leaks) and disturb and mobilise existing sources of contamination, which may pose a risk to human health and controlled waters receptors.

10.6.5. Construction activities, such as earthworks, piling, installation of drainage and other below ground services may introduce new pathways for migration of existing contamination and exposure of contaminated soil, remobilisation of contaminants through soil disturbance and the creation of preferential pathways for surface water run-off and ground gas migration. The construction work activities could potentially generate contaminated dust and vapours.

10.6.6. With the implementation of mitigation measures through design and through the construction phase, potential land contamination effects during construction have been assessed as neutral to slight which are classed as not significant. The land contamination impact assessment is presented in Appendix 10.3.

Operation

Agricultural Land and Soil

10.6.7. It is assumed that there would be no potential impacts/no further loss of agricultural land when the Scheme is operational and so impacts are confined to the construction phase.

Land Contamination

10.6.8. Environmental impacts are likely to be greatest during construction, with reduced impacts likely during operation. The operation of the Scheme may potentially introduce new sources of contamination i.e. spillages and leaks from vehicles and below ground services could create additional potential pathways for the migration of potential contamination which were not present at baseline. However, it is assumed that the Scheme will be operated in accordance with the relevant regulations and best practice guidance in applying Best Available Techniques and pollution prevention.

10.6.9. With the implementation of mitigation measures through design and through the construction phase, potential land contamination effects during construction have been assessed as neutral to slight which are classed as not significant. The land contamination impact assessment is presented in Appendix 10.3.

10.7. Potential mitigation measures

Construction

Agricultural Land and Soil

10.7.1. There is no mitigation for the permanent loss of agricultural land. Surplus soils from agricultural land, generated from the footprint of the Scheme should be reused sustainably.

10.7.2. Land occupied or disturbed during the construction process that is not permanently acquired for engineering and landscaping, such as that utilised for construction compounds, will be restored to a condition equivalent to its original. It would be subject to an aftercare period (duration to be agreed), during which time problems with settlement, drainage and weed infestation will be rectified. A Soil Handling Management Plan (SHMP) should be produced prior to any construction to ensure that the quality of soil in areas required temporarily for the proposed developed is maintained, in accordance with the Code of Practice for the Sustainable Use of Soils on Construction Sites (DEFRA, 2009a).

10.7.3. Although soils supporting other land uses have been scoped out of this assessment, a Materials Management Plan (MMP) should be implemented in accordance with the CL:AIRE Definition of Waste Code of Practice (DoWCoP) (CL:AIRE, 2011). The MMP should consider the sustainable reuse of all surplus soils generated from the Scheme, such as roadside woodlands, hedgerows and gardens (subject to contamination testing and suitable for use criteria) in the effort to reduce waste and to meet carbon targets. In addition, best practice construction methods would be included in a CEMP (i.e. dust mitigation measures).

Land Contamination

Environmental Design

10.7.4. A summary of the proposed embedded mitigation measures to be incorporated into the design of the Scheme in relation to soils and geology are likely to include:

- A ground investigation would be undertaken to inform the Scheme design and

confirm the ground conditions and contamination status of the Scheme; and

- Remediation of soil and groundwater would be undertaken prior to construction if investigation and risk assessments deem necessary.

Construction Phase

10.7.5. Potential construction mitigation measures to be included within a CEMP are likely to include:

- Health and safety risk assessments, method statements (RAMS) and appropriate Personal Protective Equipment (PPE) for the protection of construction workers in accordance with the Control of Substances Hazardous to Health (COSHH) Regulations (Health and Safety Executive, 2020);
- Implementation of appropriate dust suppression measures to prevent migration of contaminated dust and fibres as appropriate, as set out in Chapter 5 Air Quality;
- Preparation of piling risk assessments as required in accordance with Environment Agency guidance to assess and manage potential risks to controlled waters;
- Working methods during construction to manage groundwater and surface water appropriately and ensure that there is no run-off from the works, any material / waste stockpiles, and storage containers into adjacent surface watercourses in accordance with DEFRA and Environment Agency's guidance;
- Stockpile management (such as water spraying and avoiding over stockpiling to reduce compaction of soil and loss of integrity) and timely removal of stockpiled soil to prevent windblown dust and surface water run-off;
- Implementation of an appropriate MMP and Site Waste Management Plan (SWMP) to manage materials during the construction works. Further information can be found in Chapter 12 (Materials and Waste);
- Limiting the area of earthworks at any one time to reduce temporary effects on topography, soil compaction and erosion;
- Limiting the duration of soil exposure and timely reinstatement of vegetation or hardstanding to prevent soil erosion;
- Implementing appropriate pollution incident control e.g. plant drip trays and spill kits;
- Implementing appropriate and safe storage of fuel, oils and equipment during construction; and
- If unexpected contamination is encountered during proposed earthworks, further assessment will be required. Following assessment further mitigation measures such as remediation or removal of contamination may be required.

10.7.6. It has been assumed that hardstanding will be placed across the majority of the proposed works associated with the carriageway, except for soft landscaping along embankments and cuttings, which will minimise the generation of dust, direct contact and ingestion pathways and minimise infiltration during the operational phase. If soil contamination is identified, laying of a clean capping layer may be required in areas of proposed soft landscaping.

10.7.7. Drainage design will consider the risks from any residual contamination and designers may be required to use lined drainage systems in areas of contamination that may be left in situ. If soil and/or groundwater contamination is identified during the ground investigation which poses a risk to sensitive receptors, appropriate remediation will be undertaken.

10.7.8. Design of the road and the selection of construction materials would be in accordance with DMRB, British Standards and best practice guidance at the time of the design. The design would be required to take into account the ground conditions including the potential for ground gas and ground aggressivity.

Operation

Agricultural Land and Soil

10.7.9. No mitigation measures are applicable during operation.

Land Contamination

10.7.10. It is assumed that the Scheme will be operated in accordance with the relevant regulations and best practice guidance in applying Best Available Techniques and pollution prevention.

10.7.11. Furthermore, pollution prevention measures incorporated within drainage design will mitigate the risk of contamination to controlled waters. The principles of drainage design for the proposed development are summarised in Chapter 8 (Road Drainage and the Water Environment).

10.8. Residual Effects

10.8.1. Residual effects relate to those impacts which remain following the implementation of primary / embedded mitigation measures.

Construction

Agricultural Land and Soil

10.8.2. Land returning to agriculture after temporary use is expected to be of the same quality as baseline (see section 10.5). With reference to Table 4-1 of this PEIR, land returning to agriculture is anticipated to have a slight/moderate adverse temporary effect, with no residual effects. This is considered not significant effect.

10.8.3. Flood compensation areas (assuming it returns to agricultural use) will be one or two ALC grades poorer than the ALC grade assigned to the land prior to construction and no longer of BMV. This is due to increasing the frequency and duration of flood events, decreased drainage capability and degraded soil structure where subsoil is removed to lower the ground level. With reference to Table 4-1 of this PEIR, under the current design, this impact is anticipated to have a moderate to large, adverse residual effect. This is considered a significant effect,

10.8.4. With regards to the permanent land take for the new road layout and for attenuation basins, moderate to very large, adverse residual effects are anticipated, which is a significant effect.

Land Contamination

10.8.5. With the implementation of embedded mitigation measures neutral or slight effects are mainly anticipated during construction. Consequently, there are anticipated to be no residual impacts.

Operation

Agricultural Land and Soil

10.8.6. No residual effects are anticipated during the operation of the Scheme.

Land Contamination

10.8.7. With the implementation of embedded mitigation measures neutral or slight effects are mainly anticipated during operation. Consequently, there are anticipated to be no residual impacts.

10.9. Cumulative effects

10.9.1. Cumulative effects on geology and soils may occur from interaction with other committed and planned developments in the vicinity of the Scheme. The RFFP in Chapter 15 provides a list of these developments (at the time of the submission of the PEIR). The cumulative effects of the Scheme and these other developments on geology and soils will be addressed as part of the ES process.

10.10. NPS compliance

10.10.1. A summary of compliance with the topic specific requirements in the NPS NN is provided in Table 10-9 below.

Table 10-9 - Requirements of the NPS NN

Reference	NPS topic requirement	How the requirement has been addressed
Paragraph 5.22	The applicant should ensure that the ES clearly sets out any likely significant effects on internationally, nationally and locally designated sites of ecological or geological conservation importance.	Environmental Protection Areas in which the supporting soils could be directly affected were scoped out of the geology and soils assessment at the scoping stage. Geological features of local, regional, national, or international importance have also been scoped out of the assessment.
Paragraph 5.25	Development should avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives.	Environmental Protection Areas in which the supporting soils could be directly affected were scoped out of the geology and soils assessment at the scoping stage. Geological features of local, regional, national, or international importance have also been scoped out of the assessment.
Paragraph 5.168	Applicants should take into account the benefits of BMV agricultural land. Applicants should also identify any effects, and seek to minimise impacts on soil quality, taking into account any mitigation measures proposed.	Impacts to BMV agricultural land have been assessed and mitigation measures have been identified to minimise impacts on soil quality.
Paragraph 5.168	For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination.	A risk assessment and impact assessment have been undertaken to assess the risk posed by current and historical potentially contaminative land uses on and surrounding the Scheme.
Paragraph 5.179	Applicants should minimise the direct effects of a project by the application of good design principles, including the layout of the project and the protection of soils during construction.	Mitigation measures which will be implemented to minimise impacts are considered as part of the assessment section in this chapter.

10.11. Assumptions and limitations

10.11.1. A realistic assumption on ground conditions and impacts has been made, based on the data available at the time of reporting i.e. the Envirocheck report and publicly available desk based/website data. The assessment will be updated and revised using site specific information obtained from ground investigation, scheduled to be completed in October 2021.

10.11.2. As detailed design will not be finalised until post consent, the likely 'reasonably likely worse case' impact from the route options has been assumed in the assessment and is sought to be mitigated.

10.11.3. For the purpose of this preliminary assessment, areas not previously surveyed have been identified as BMV or non BMV, and where there is enough information from within the vicinity to confidentially assign a grade, this has been done and noted on Figure 10-1.

10.11.4. For the assessment of effects associated with ground conditions and land contamination, the following assumptions have been made:

- Contamination is assumed to be present at all locations where potential sources have been identified in the study area;
- Ground disturbance during the construction phase could occur anywhere within the route options;
- The assessment provides an initial indication of chronic long-term risks to construction and maintenance workers. Control measures to mitigate the risk of adverse health impacts to construction workers will be identified by risk assessments and will be incorporated into the CEMP; and
- There will be areas used for the storage of materials, waste and containers during the construction and operational phase. Where storage/stockpiling of materials occurs, the material will stay within the route options boundary.

10.12. Chapter summary

10.12.1. A total of 4 ha of subgrade 3a ALC is anticipated to be lost resulting in a large adverse effect which is significant. A total of 4 ha of subgrade 3b ALC land is also anticipated to be lost resulting in a moderate effect which is significant. A further 55 ha of Subgrade 3a and 3b ALC land is anticipated to have permanent restriction due to being located within flood compensation areas resulting in a moderate effect which is significant.

10.12.2. Land returning to agriculture after temporary use is expected to be of the same quality as baseline and is anticipated to have a slight/moderate adverse temporary effect, with no residual effects.

10.12.3. The minor impacts to agricultural land are not anticipated to have significant effects. The major and moderate impacts to agricultural land are anticipated to have moderate to very large adverse residual effects and therefore are considered significant.

10.12.4. With respect to land contamination, the sensitivity of the receptor and the magnitude of the potential impact (change) of the Scheme has been assessed as not significant.

The discipline specific chapters of this PEIR have been produced as separate documents.

11. Cultural Heritage

12. Materials and Waste

13. Population and Human Health

14. Climate

15. Cumulative Effects Assessment

Appendices to the Geology and Soils chapter

- Appendix 10.1
- Appendix 10.2
- Appendix 10.3
- Appendix 10.4

Appendix 10.1 Definitions of Probability and Consequence

Table A-1 - Risk estimation - classification of probability

Classification	Definition of the probability of harm / pollution occurring
High Likelihood	The contaminant linkage exists, and it is very likely to result in harm / pollution in the short term, and/or will almost inevitably result in harm / pollution in the long term, and/or there is current evidence of harm/pollution. Likelihood is defined as more likely than not and meets the definition of 'significant possibility' within Part 2A Contaminated Land Statutory Guidance.
Likely	The source, pathway and receptor exist for the contaminant linkage and it is probable that harm / pollution will occur. Circumstances are such that harm / pollution is not inevitable, but possible in the short term and likely over the long term. Likelihood is defined as reasonably possible and meets the definition of 'significant possibility' within Part 2A Contaminated Land Statutory Guidance.
Low Likelihood	The source, pathway and receptor exist, and it is possible that harm / pollution could occur. Circumstances are such that harm/pollution is by no means certain in the long term and less likely in the short term.
Unlikely	The source, pathway and receptor exist for the contaminant linkage, but it is improbable that harm / pollution will occur even in the long term.

Table A-2 - Risk estimation - classification of consequence

Classification	Definition of consequence
	Human Health Receptors – Site end user or other sensitive receptor
Severe	Acute damage to human health based on the effects on the critical human receptor. Concentrations of contaminants above appropriate site specific assessment criteria. Harm meets definition of 'significant harm' within Part 2A Contaminated Land Statutory Guidance.
Medium	Chronic damage to human health based on the effects on the critical human receptor. Concentrations of contaminants above appropriate site specific assessment criteria. Harm meets definition of 'significant harm' within Part 2A Contaminated Land Statutory Guidance.
Mild	No appreciable impact on human health based on the potential effects on the critical human receptor. Concentrations of contaminants above generic assessment criteria but below appropriate site specific assessment criteria.
Minor	No appreciable impact on human health based on the effects on the critical human receptor. Concentrations of contaminants below appropriate generic assessment criteria.
	Human Health Receptors – Site construction workers
Severe	Exposure to hazardous substances resulting in a reportable death, major injury, 3-day injury or illness/disease under RIDDOR.
Medium	Exposure to hazardous substances resulting in a dangerous occurrence reportable under RIDDOR. Exposure to hazardous substances resulting in exceedance of a workplace exposure limit.

Classification	Definition of consequence
Mild	Exposure to hazardous substances resulting in limited effects such as headache, dizziness, nausea. Exposures below the workplace exposure limits. Not reportable under RIDDOR.
Minor	Minor exposure to hazardous substance resulting in no appreciable ill health effects.
	Controlled Water Receptors
Severe	Pollution of a Principal Aquifer within a source protection zone or potable supply characterised by a breach of drinking water standards. Pollution of a surface water course characterised by a breach of an Environmental Quality Standard (EQS) at a statutory monitoring location or resulting in a change in General Quality Assessment (GQA) grade of river reach. Discharge of a List I or List II substance to groundwater. Pollution meets Part 2A Contaminated Land Statutory Guidance definition.
Medium	Pollution of a Principal Aquifer outside a source protection zone or a Secondary A Aquifer characterised by a breach of drinking water standards. Pollution of an industrial groundwater abstraction or irrigation supply that impairs its function. Substantial pollution but insufficient to result in a change in the GQA grade of river reach Pollution meets Part 2A Contaminated Land Statutory Guidance definition.
Mild	Low levels of pollution of a Principal Aquifer outside a source protection zone or an industrial abstraction, or pollution of a Secondary Aquifer. Low levels of pollution insufficient to result in a change in the GQA grade of river reach, pollution of a surface water course without a quality classification.
Minor	No appreciable pollution, or pollution of a low sensitivity receptor such as a non-aquifer or a surface water course without a quality classification
	Property Receptors – Buildings, Foundations and Services
Severe	Catastrophic damage to buildings, such as explosion. Catastrophic failure of foundations and services. Substantial damage to a Scheduled Monument significantly impairing the by reason of which the monument is scheduled. Harm meets definition of ‘significant harm’ within Part 2A Contaminated Land Statutory Guidance.
Medium	Substantial damage to buildings and foundations rendering the structures unsafe. Substantial damage to services impairing their function. Significant damage to a Scheduled Monument significantly impairing the reason of which the monument is scheduled. Harm meets definition of ‘significant harm’ within Part 2A Contaminated Land Statutory Guidance.
Mild	Significant damage to buildings and foundations but not resulting in them being unsafe for occupation. Damage to services but not sufficient to impair their function. Damage to a Scheduled Monument but no significant impairment to the reason of which the monument is scheduled.
Minor	Easily repairable damage to buildings, foundations and services.

Appendix 10.2 Preliminary Conceptual Site Models

Table B-1 - Conceptual Site Model

Source	Receptor		Pathway	Potential Consequence	Probability	Risk	Comment
On-site: Made Ground associated with the construction of existing (M5, A4019 and B4634) and proposed carriageways and activities associated with their operation; and Agricultural activities.	Human health: On-site	Construction and maintenance workers of current roads	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts and water. Inhalation of contaminants in soil, soil-derived dust, fibres, gas and vapours.	Medium	Unlikely	Low	There will be short term exposure of soils during construction although best practice site management procedures are likely to be implemented which will minimise short term exposure risk. It is assumed that users of the Link Road, A4019, B4634 and motorway junction are likely to be transient. Post construction works, the site will comprise hardstanding road surfaces minimising potential for end users to come into direct contact with soils or for dust to be generated. Ground gases are unlikely to be a significant concern as no enclosed structures are proposed as part of the Scheme and infrastructure is likely to be vented. Future maintenance within the proposed option locations may require localised excavation with potential for workers to come into direct contact with soils or inhale soil derived dusts. This work is likely to be short term and infrequent. Works will be risk assessed and best practice controls are likely to be used (e.g. gloves, and protective clothing) minimising potential for exposure.
		Pedestrians accessing existing roads, footpaths and public rights of way	Inhalation of contaminants in soil-derived dust, fibres, gas and vapours.	Medium	Unlikely	Low	
		Current road users	Inhalation of contaminants in soil-derived dust, fibres, gas and vapours.	Medium	Unlikely	Low	
		Users of the new road Scheme	Inhalation of contaminants in soil-derived dust, fibres, gas and vapours.	Medium	Unlikely	Low	
		Farmers and workers on agricultural land	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts and water. Inhalation of contaminants in soil, soil-derived dust, fibres, gas and vapours.	Medium	Unlikely	Low	
	Human health: Off-site	Residents in adjacent properties and users of adjacent commercial / industrial premises	Dermal contact with and ingestion of contaminants in soil-derived dusts and water that may have migrated off-site Inhalation of soil-derived dust, fibres, gas and vapours which may have migrated off-site.	Medium	Unlikely	Low	Following the construction of the proposed carriageways and motorway junction improvement works ground cover at the proposed option locations will comprise hardstanding with minimal areas of exposed bare soil therefore it is unlikely that off-site human health receptors will be come into direct contact / ingest potential soil contaminants.
		Pedestrians accessing surrounding roads, footpaths and public rights of way	Dermal contact with and ingestion of contaminants in soil-derived dusts and water that may have migrated off-site	Medium	Unlikely	Low	

Source	Receptor		Pathway	Potential Consequence	Probability	Risk	Comment
			Inhalation of soil-derived dust, fibres, gas and vapours which may have migrated off-site.				
		Farmers and workers on agricultural land	Dermal contact with and ingestion of contaminants in soil-derived dusts and water that may have migrated off-site Inhalation of soil-derived dust, fibres, gas and vapours which may have migrated off-site.	Medium	Unlikely	Low	
	Controlled Waters: groundwater	Groundwater in Secondary undifferentiated and Secondary A bedrock aquifer Groundwater in Secondary A Superficial aquifer	Leaching of contaminants in soil to groundwater in underlying aquifers	Medium	Low Likelihood	Moderate/Low	The study area is underlain by intermittent deposits of the superficial Alluvium and Cheltenham Sand and Gravels. Bedrock underling the study area comprises the Rugby Limestone Formation and the Charmouth Mudstone Formation. The Alluvium, Cheltenham Sand and Gravels and Rugby Limestone Formation are all classified as Secondary A aquifers. The works are likely to result in disturbance of soils during excavation and construction which may result in the release of contaminants in unsaturated Made Ground soils with potential migration to groundwater.
			Migration of contaminated water through preferential pathways such as underground services, pipes and granular material to groundwater in underlying aquifers.	Medium	Low Likelihood	Moderate/Low	
	Controlled Waters: Surface waters (on-site)	River Chelt, Leigh Brook and surface water drains	Lateral migration of contaminated groundwater with discharge to surface watercourses	Medium	Low Likelihood	Moderate/Low	The construction works are likely to result in disturbance of shallow unsaturated soils which may result in the release of contaminants in unsaturated Made Ground soils with potential migration to surface water. Best practice procedures require implementation to minimise leaching of unsaturated soils in excavations and stockpiles.
			Discharge of contaminants entrained in groundwater and/ or surface water run-off followed by overland flow and discharge.	Medium	Low Likelihood	Moderate/Low	
	Controlled Waters: Surface waters (off-site)	River Chelt, Leigh Brook and surface water drains	Lateral migration of contaminated groundwater with discharge to surface watercourses as base flow	Medium	Low Likelihood	Moderate/Low	
			Discharge of contaminants entrained in groundwater and/or surface water run-off followed by overland flow and discharge.	Medium	Low Likelihood	Moderate/Low	
Off-site: Made Ground associated with the construction and operation of adjacent roads; Historical sewage works / farm (Cheltenham Corporation) 260 m west; Allotments and agricultural	Human health: On-site	Construction and maintenance workers of current roads	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts and water. Inhalation of contaminants in soil, soil-derived dust, fibres, gas and vapours.	Medium	Unlikely	Low	Potentially contaminated groundwater may migrate to the site from off-site sources with the potential for direct contact in excavations. This work is likely to be short term and infrequent. Works will be risk assessed and best practice controls are likely to be used (e.g. gloves, and protective clothing) minimising potential for exposure.

Source	Receptor		Pathway	Potential Consequence	Probability	Risk	Comment
activities within the surrounding area; Historical corn mill 190 m west; Historical smithy 250 m east; Historical engineering works 250 m south east; Sainsburys petrol station 200 m north and the Cheltenham Filling Station 360 m south east; Violet Villa historical landfill 30 m north east and Colman Farm historical landfill 200 m north; and Waste management facility 340 m north west of the A4019.							
		Pedestrians accessing existing roads, footpaths and public rights of way	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts and water. Inhalation of contaminants in soil, soil-derived dust, fibres, gas and vapours.	Medium	Unlikely	Low	
		Current road users	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts and water. Inhalation of contaminants in soil, soil-derived dust, fibres, gas and vapours.	Medium	Unlikely	Low	
		Users of the new road Scheme	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts and water. Inhalation of contaminants in soil, soil-derived dust, fibres, gas and vapours.	Medium	Unlikely	Low	
		Farmers and workers on agricultural land	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts and water. Inhalation of contaminants in soil, soil-derived dust, fibres, gas and vapours.	Medium	Unlikely	Low	
	Controlled Waters: groundwater	Groundwater in Secondary undifferentiated and Secondary A bedrock aquifer Groundwater in Secondary A Superficial aquifer	Leaching of contaminants in soil to groundwater in underlying aquifers.	Medium	Low Likelihood	Moderate/Low	Potentially contaminated groundwater may migrate to the site from off-site sources. The depth to groundwater is currently unknown.

Source	Receptor		Pathway	Potential Consequence	Probability	Risk	Comment
			Migration of contaminated water through preferential pathways such as underground services, pipes and granular material to groundwater in underlying aquifers.	Medium	Low Likelihood	Moderate/Low	
	Controlled Waters: Surface waters (on-site)	River Chelt, Leigh Brook and surface water drains	Lateral migration of contaminated groundwater with discharge to surface watercourses.	Medium	Low Likelihood	Moderate/Low	Potentially contaminated groundwater may migrate to the site from off-site sources, potentially affecting surface water in the River Chelt and Leigh Brook.
			Discharge of contaminants entrained in groundwater and/or surface water run-off followed by overland flow and discharge.	Medium	Low Likelihood	Moderate/Low	

Appendix 10-3 Land Contamination Impact Assessment Tables

Table C-1 - Construction phase effects of land contamination for the Scheme.

Receptor Group	Receptor	Value / Sensitivity	Magnitude of Impact	Effect	Significance
Human health: On-site	Construction and maintenance workers of current roads	Medium	Minor	Neutral or slight	Not Significant
	Pedestrians accessing existing roads, footpaths and public rights of way	Low	Minor	Neutral or slight	Not Significant
	Current road users	Low	Minor	Neutral or slight	Not Significant
	Users of the new road Scheme	Low	Minor	Neutral or slight	Not Significant
	Farmers and workers on agricultural land	Medium	Minor	Slight	Not Significant
Human health: Off-site	Residents in adjacent properties	Very high	Negligible	Slight	Not Significant
	users of adjacent commercial / industrial premises	Medium	Negligible	Slight	Not Significant
	Pedestrians accessing surrounding roads, footpaths and public rights of way	Low	Minor	Neutral or slight	Not Significant
	Farmers and workers on agricultural land	Medium	Minor	Slight	Not Significant
Controlled Waters: groundwater	Groundwater in Secondary A Super aquifers (Alluvium and Cheltenham Sand and Gravel)	Medium	Minor adverse	Slight	Not Significant
	Groundwater in Secondary A bedrock aquifer (Rugby Limestone Formation)	Medium	Minor adverse	Slight	Not Significant
	Groundwater in Secondary bedrock undifferentiated aquifer (Charmouth Mudstone Formation)	Low	Minor adverse	Neutral or slight	Not Significant

Controlled Waters: Surface waters (on-site)	River Chelt, Leigh Brook and surface water drains	High	Minor adverse	Neutral or slight	Not Significant
Controlled Waters: Surface waters (off-site)	River Chelt, Leigh Brook and surface water drains	High	Minor adverse	Neutral or slight	Not Significant

Table C-2 - Operation phase effects of land contamination for the Scheme.

Receptor Group	Receptor	Value / Sensitivity	Magnitude of Impact	Effect	Significance
Human health: On-site	Construction and maintenance workers of current roads	Medium	Negligible	Neutral or slight	Not Significant
	Pedestrians accessing existing roads, footpaths and public rights of way	Low	Negligible	Neutral or slight	Not Significant
	Current road users	Low	Negligible	Neutral or slight	Not Significant
	Users of the new road Scheme	Low	Negligible	Neutral or slight	Not Significant
	Farmers and workers on agricultural land	Medium	Negligible	Neutral or slight	Not Significant
Human health: Off-site	Residents in adjacent properties	Very high	Negligible	Slight	Not Significant
	users of adjacent commercial / industrial premises	Medium	Negligible	Slight	Not Significant
	Pedestrians accessing surrounding roads, footpaths and public rights of way	Low	Negligible	Neutral or slight	Not Significant
	Farmers and workers on agricultural land	Medium	Negligible	Neutral or slight	Not Significant
Controlled Waters: groundwater	Groundwater in Secondary A Super aquifers (Alluvium and Cheltenham Sand and Gravel)	Medium	Negligible	Neutral or slight	Not Significant

	Groundwater in Secondary A bedrock aquifer (Rugby Limestone Formation)	Medium	Negligible	Neutral or slight	Not Significant
	Groundwater in Secondary bedrock undifferentiated aquifer (Charmouth Mudstone Formation)	Low	Negligible	Neutral or slight	Not Significant
Controlled Waters: Surface waters (on-site)	River Chelt, Leigh Brook and surface water drains	High	Negligible	Neutral or slight	Not Significant
Controlled Waters: Surface waters (off-site)	River Chelt, Leigh Brook and surface water drains	High	Negligible	Neutral or slight	Not Significant

Appendix 10.4 Agricultural Land Survey Report

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1. Introduction

1.1.1. This report is based on an Agricultural Land Classification (ALC) survey carried out within the Project Control Framework (PCF) Stage 2 options' boundary (Option 2) in December 2020. The aim was to assign ALC Grades and identify areas of Best and Most Versatile (BMV) land (described in Section 5.1) for permanent land take required for the proposed West Cheltenham Link Road and associated attenuation ponds. This is in response to Design Manual for Roads and Bridges (DMRB) LA109[1], Geology and Soils paragraph 3.6.1, which states that a soil resource and/or ALC survey should be undertaken to inform the baseline scenario and assessment conclusions, where data is incomplete or unavailable.

1.1.2. The extent of likely BMV land for the whole Scheme was included in the PCF 2 Scoping Report[2] and Preliminary Environmental Assessment of Options Report[3] to inform the comparison of Scheme Options, but this ALC survey report containing soil profile data and actual ALC Grades is intended for use to inform the Preliminary Environmental Information Report (PEIR)[4] and PCF 3. The ALC Grades identified by the ALC survey are displayed in Appendix A. The estimated BMV land required for the link road and associated attenuation ponds is provided in Table 5-1.

1.1.3. Some land in other areas of the Scheme have already been surveyed for ALC for strategic planning purposes (available on the DEFRA MAGIC online database[5]) and the results of these are included in the PEIR. The extent of temporary land take and flood compensation areas is not confirmed but are likely to be placed in areas that have not been surveyed, therefore there may be a requirement to return to the area to carry out further ALC surveys.

1.1.4. The soil information gathered during the survey has also been interpreted to provide an indicative/outline Soil Handling and Management Plan and to describe the potential of the soil for the possible uses of surplus soil generated by construction.

[1] Highways England (2019). DMRB LA 109: Geology and Soils. Accessed on 8th June 2021 from https://www.standardsforhighways.co.uk/dmrb/search/adca4c7d-4037-4907-b633-76eaed30b9c0
[2] Atkins (2020). M5 Junction 10 Improvements. Scoping Report. Document Reference: GCCM5J10-ATK-EGT-ZZ-FN-LM-000001
[3] Atkins (2019). M5 Junction 10 Improvements. Preliminary Environmental Assessment of Options Report. Document Reference: GCCM5J10-ATK-EGN-XX-RP-LM-000002
[4] Atkins (2021). M5 Junction 10 Improvements. Preliminary Environmental Information Report. Document Reference: GCCM5J10-ATK-EGN-ZZ-RP-LM-000001
[5] DEFRA, Multi-Agency Geographic Information for the Countryside (MAGIC), www.magic.gov.uk [accessed August 2021]

2. The Scheme

2.1.1. M5 Junction 10 is located four miles to the north-west of Cheltenham and eight miles to the north-east of Gloucester. The location of M5 Junction 10 is shown in Figure 2-1.

Figure 2-1 - Location of the Scheme

2.1.2. The proposed infrastructure improvement elements that make up the Scheme are illustrated in Figure 2-2. The link road and attenuation ponds (circled in red) is the 2020 ALC survey study area.

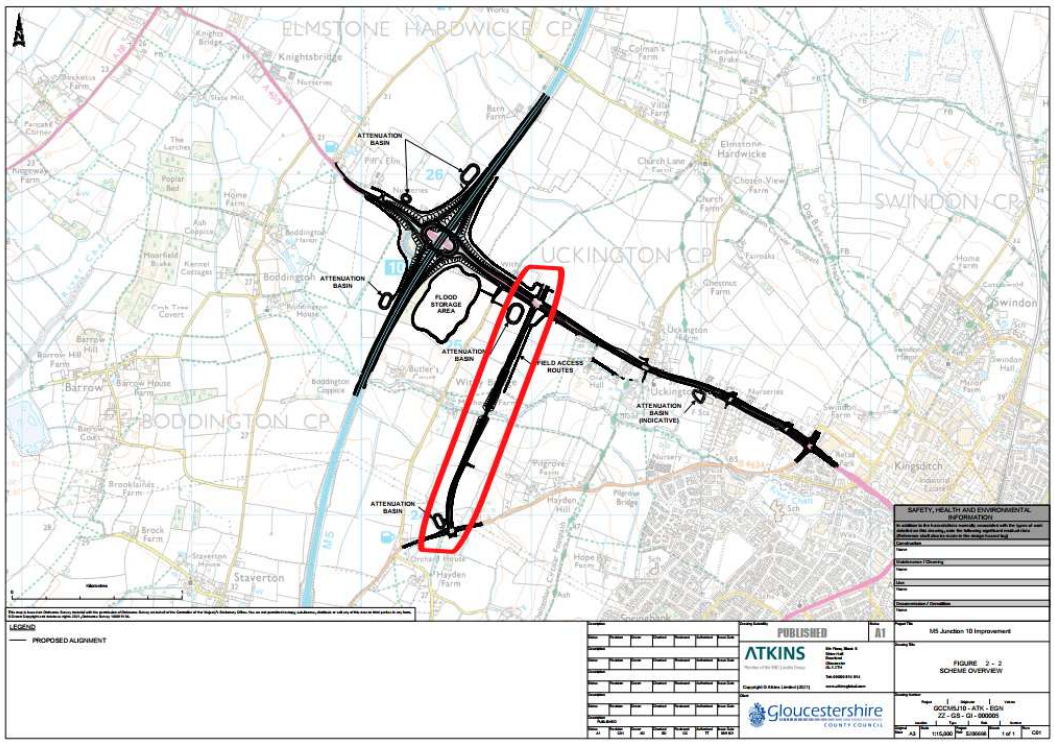


Figure 2-2 - The Scheme. The red oval highlights the study area of the ALC undertaken in 2020 Baseline data

2.2. Environmental setting

2.2.1. The area is predominantly rural, with the land-use being a combination of arable and grazing pasture. Traditional orchards are widespread and the area also contains important areas of lowland meadow and floodplain grazing marsh. The dominant arable and grassland habitats are interspersed with pockets of other terrestrial habitats, notably broadleaved and mixed plantation woodland, traditional orchards and unimproved and semi-improved neutral grassland.

2.2.2. Multiple watercourses cross the Scheme area (notably the River Chelt, Leigh Brook and River Swilgate) running from east to west, which join the River Severn approximately 7.5 km downstream of the Scheme.

2.2.3. Review of the Environment Agency flood map[6] indicates that the area to the north of the A4019 and east of the M5 is affected by surface water and river flooding. Land just south of the A4019 and extending either side of the existing M5 Junction 10 is floodplain for the River Chelt and falls within Flood Zones 2 and 3, where medium and high probability of flooding is recognised. To the immediate north of the A4019 is the floodplain of the Leigh Brook. This is not included in Flood Zone 3 but is known to flood. There is also land in Flood Zone 3 near Stoke Orchard, to the north-east of M5 Junction 10, associated with the River Swilgate and its tributary Dean Brook.

2.2.4. With reference to the Met. Office Climatological Data for ALC[7], the general climate of the area is typified by relatively mild winters and warm summers, with higher than UK average mean and maximum monthly temperatures. The long-term average monthly rainfall is lower than the UK average (based on 1981 – 2010 data), as are the average number of days in which heavy rainfall was experienced. In the future, it is projected that on average, the area is likely to experience hotter, drier summers and warmer, wetter winters. Alongside these changes in the average conditions, it is likely that climate change will increase the frequency and severity of extreme weather events such as heavy rainfall, storms and heatwaves. Climatological data associated with identifying the ALC Grade is presented in Table 2-1.

2.3. Published geology and soil information

Geology

2.3.1. The British Geological Survey (BGS) GeoIndex[8] indicates that superficial deposits of Cheltenham Sand and Gravel and Alluvium are present along the alignment of the existing watercourses, sections of the M5 and the A4019 between the M5 Junction 10 and Cheltenham. Charmouth Mudstone bedrock underlies the majority of the Scheme and study area, with the Rugby Limestone Member present in the south-west of the study area.

Soil

2.3.2. The only available published soil map for the study area is the 1:250,000 scale National Soil Map of England and Wales, Sheet 5, South West England[9], which illustrates the soil associations present in the region. The map displays soils of the Badsey 2 association present on the Cheltenham Sand and Gravel Deposit, consisting of mainly well drained calcareous fine loamy soils. Soils on the Alluvium of the River Chelt are mapped as stoneless, clayey soils (in places calcareous and variably affected by groundwater) of the Fladbury 1 association. The soils of the Charmouth Mudstone Formation are mapped as the Evesham 2 association of slowly permeable calcareous clayey soils, with some slowly

[6] Environment Agency, Flood Risk Map for Planning, https://flood-map-for-planning.service.gov.uk/ [accessed August 2021]
[7] MET (1989). Climatological dataset for ALC. Accessed on 8th June 2021 from http://publications.naturalengland.org.uk/publication/6493605842649088
[8] BGS (2021). Onshore Geoindex. Accessed on 8th June 2021 from https://mapapps2.bgs.ac.uk/geoindex/home.html
[9] Soil Survey of England and Wales (1983). Soils of England and Wales, Sheet 5 South West England, Rothamsted Experimental Station, Harpenden

permeable seasonally waterlogged non-calcareous clayey and fine loamy or fine silty over clayey soils. In the vicinity of the Cheltenham Sand and Gravel Deposit, the topsoil is lighter, improving the structure and drainage.

2.4. Climatological data for ALC

2.4.1. The local climatic parameters relevant to ALC have been taken from the Met. Office Climatological Data for ALC[10] and are provided in Table 2-1 for a location close to the M5 at Ordnance Survey national grid reference SO 900 250. The chosen location is considered representative for the extent of the Scheme and study area. These values are utilised in Section 6 of this report to assign wetness classes to the profiles and are used in calculating the droughtiness of the profile.

Table 2-1 - Climatological data

Parameter	Unit	Measure
Average annual rainfall (AAR)	mm	624
Field Capacity Days (FCD)	Days	138
Accumulated temperature (AT0)	Day °C	1491
Moisture deficit wheat (MDW)	mm	114
Moisture deficit potatoes (MDP)	mm	108
Height above mean sea level (ALT)	m	25

2.5. Weather conditions

2.5.1. The Met Office climatological records were reviewed to summarise the weather conditions in the week preceding the survey work (10th and 11th December 2020) for Cheltenham.

2.5.2. There was an average temperature of 2.6°C and a total of 7mm rainfall recorded during the week preceding the survey[11]. Standing water was present on fields within the survey area on either side of the A4019.

[10] MET (1989). Climatological dataset for ALC. Accessed on 8th June 2021 from http://publications.naturalengland.org.uk/publication/6493605842649088
[11] World Weather Online (2021). Accessed on 8th June 2021 from https://www.worldweatheronline.com/cheltenham-weather-history/gloucestershire/gb.aspx

3. Survey methodology

3.1.1. The survey was carried out by a Soil Surveyor with more than 15 years' experience of soil/ALC surveys and meeting the British Society of Soil Science (BSSS) ALC competency standards. The Soil Surveyor was accompanied by a field assistant who is a full member of the BSSS and is working towards the BSSS ALC competency standards.

3.1.2. The survey area comprised the proposed link road, between the A4019 in the north and the B4634 in the south, and associated attenuation ponds. Soils were examined at a total of 14 survey points at approximately 100 m intervals where access was available. Non-agricultural land (such as woodland, embankments and shrubland) was not included in the survey.

3.1.3. Information at each survey point was recorded in accordance the Ministry of Agriculture, Fisheries and Food (MAFF) ALC of England and Wales Revised guidelines and criteria for grading the quality of agricultural land[12] (see Section 5).

3.1.4. Augering was completed to 120 cm depth (where possible) using a 4cm diameter Dutch auger. Soil properties including texture, structure (where suitable), colour and mottling (using a Munsell colour chart[13]), stone content and rooting depth were recorded at each location using the methods in the Soil Survey Field Handbook[14]. Site conditions such as gradient (using a Suunto Clinometer), exposure, microrelief and aspect were noted for each survey point. Weak hydrochloric acid (10%) was used to confirm the presence and indicative amount of calcium carbonate in each horizon.

3.1.5. The texture of the soil was determined by hand texturing, which requires rubbing a moist sample of soil between the thumb and fingers to detect proportions of sand, silt and clay. Clay content as a percentage was also estimated when heavy soils were encountered (clay content greater than 27% as this is relevant to assigning ALC).

3.1.6. Any additional information, such as the depth to the water table where it was encountered, was also noted.

3.1.7. The coordinates (eastings and northings) and elevation at each survey point were measured using a Garmin GPS 12.

3.1.8. Results of the survey at each investigation point are provided in Appendix B. Particle Size Analysis of three soil samples sent to a laboratory are provided in Appendix C.

[12] MAFF (1988). Revised guidelines and criteria for grading the quality of agricultural land. Accessed on 8th June 2021 from http://publications.naturalengland.org.uk/publication/6257050620264448
[13] Baltimore. (1975). Munsell Soil Color Charts, Maryland 21218, USA.
[14] Hodgson, J.M. (1997). Soil Survey Field Handbook.

4. Soil series

4.1.1. The profiles encountered in the December 2020 ALC survey reflect the published soil and geology maps. The Badsey series, slightly calcareous sandy clay loams with little gleying encountered above 40cm, was present in the northern extent of the survey area (the proposed link road).

4.1.2. Progressing south, from the Cheltenham Sand and Gravel Deposit and onto the River Chelt Alluvium, the profiles were stoneless, non-calcareous, gleyed clay soils of the Fladbury series. Due to limited land access, the extent of the Fladbury series could not be confirmed but it is anticipated to be present to the edge of the mapped Alluvium[8].

4.1.3. On the southern extent of the survey study area, the Evesham series of stoneless, slightly calcareous, gleyed clay soils was encountered.

5. ALC interpretation

5.1. Agricultural Land Classification

5.1.1. The MAFF guidance provides a framework for classifying land according to the extent to which its characteristics impose long-term limitations on agricultural use. ALC Grades are split into Grade 1, Grade 2, Subgrade 3a, Subgrade 3b, Grade 4 and Grade 5. Grade 1 land is of excellent quality and Grade 5 land is of very poor quality. Grades 1 and 2 and Subgrade 3a are of BMV land[12].

5.1.2. An overall ALC Grade has been ascribed to each survey location completed based on the most limiting factor identified. Limitations do not have an accumulative effect on Grade. The overall Grade at each survey point is provided in Appendix B and shown collectively on Figure 1 in Appendix A. Table 5-1 provides an estimate of the likely extent of BMV in the survey area.

5.1.3. Subgrade 3a BMV land is present on the northern extent of the link road, limited by droughtiness. Subgrade 3b non-BMV land is present across the Alluvium and mudstone to the southern extent of the link road which is limited by wetness.

Table 5-1 - Areas assigned to each ALC Grade within the proposed link road and attenuation ponds

ALC Grade	Area (ha)	Percentage of survey study area (%)
Subgrade 3a (BMV)	2.8	40
Subgrade 3b (non-BMV)	4.2	60

5.1.4. Considering the required link road intersects the BMV land (which is effectively dictated by the perpendicular river alignment/alluvial deposits), there is not considered to be an alternative route which would require less BMV land take.

5.1.5. The following sections provide a summary of the main features considered in assigning the overall ALC Grade.

5.2. Climate

5.2.1. Climatic conditions at the site do not limit the Grade of the land. With reference to Figure 1 of the ALC guidance[12], AAR of 624 and AT0 of 1491 equates to Grade 1. FCD are relatively low and therefore not a significantly limiting factor when determining wetness Grades.

5.3. Site

5.3.1. Site conditions such as gradient, exposure and microrelief are not considered to be limiting factors in the survey area.

5.3.2. Although the size, structure and location of farms, the standard of fixed equipment and the accessibility of land may influence land use decisions, they do not affect grading. Therefore, they are not considered in this report.

5.3.3. As described in Section 2.2, some of the area is prone to flooding. Where these events occur, they are considered an overriding limitation to the land quality. The duration and frequency of flooding would suggest that the corridor either side of the River Chert would be Subgrade 3b on flood events, whilst the remainder of the study area is Subgrade 3a on flood events.

5.4. Soil

5.4.1. The texture and structure of soil both have major influences on wetness and droughtiness of the profile[12]. The features effect the ability of the soil as a growing medium and can affect its workability. Calcareous soils tend to be of better quality as they enhance drainage capability and soil structure.

5.4.2. In the northern extent of the survey area, textures comprised a sandy clay loam over sandy clay. Profiles of the Fladbury and the Evesham in the centre and south of the study area respectively, were heavy clays.

5.4.3. Soil depth was not a limitation, as soil thickness was to at least 60 cm in each profile.

5.5. Interactive limitations

5.5.1. Wetness class (WC) defines the duration and depth of waterlogging. The soils in the study area vary from WC I (rarely wet), WC II (slight seasonal waterlogging), WC III (seasonal waterlogging) to WC IV (frequent waterlogging)[12]. WC I soils tend to be present in the north, on the better drained sand and gravels. WC was the most limiting factor to ALC Grade for the Fladbury and Evesham profiles.

5.5.2. An adequate supply of water throughout the growing season is required to achieve a full crop yield. Crops on land where rainfall is low and the quantity of soil moisture available in the growing season is constrained by texture, stoniness, soil structure, are likely to experience drought. The ALC guidance provides two calculations for droughtiness to assign a Grade to this potential limitation. One is for wheat (assuming a full crop rooting depth to 120cm) and the other is for potatoes (assuming a full crop rooting depth to 70cm). The values presented in Table 2-1 were used to calculate droughtiness for each horizon in the 14 profiles (factoring in texture, stone and soil structure information) using crop-adjusted available water capacity and moisture deficit. The potential for irrigation of droughty land is not taken into account when assigning an ALC Grade.

5.5.3. Results of the droughtiness calculations are provided with the profile descriptions in Appendix B. The majority of profiles above the floodplain are in sand and gravel deposits. The sandiest soils at the north of the proposed link road area are Subgrade 3b because of drought. Drought is not a limitation to the alluvial soils or mudstone soils.

5.5.4. There was little evidence of erosion occurring along the study area. The majority of fields were covered with grass and were mostly flat with little risk of rapid runoff into drainage ditches. Rills were not noted on any of the fields.

5.5.5. Crops on sandy textured soils, which lose heat rapidly at night, are prone to frost damage where cold air flows to low ground. There were no fields surveyed with a sandy topsoil and a gradient >2° and so frost risk was not considered to be a limiting factor.

6. Unsurveyable land

6.1.1. There were two relatively small land parcels where access was not granted. These coincide with the transition between the Fladbury and Evesham. Due to the predictability of the clay parent material and minor variations in landform, the ALC Grades, where the proposed route passes through these holdings, have been predicted with high confidence, using available information and professional judgement.

7. Soil handling

7.1.1. Before construction commences, a document should be prepared which describes the methods to be implemented for soil handling during the construction of the scheme. This should include methods for stripping, stockpiling, reinstatement, restoration targets (where the land is returning to agricultural use after temporary works) and opportunities for sustainable soil reuse where soils will be permanently displaced by the Scheme.

7.1.2. In general terms, all alluvial and heavy clay soils which require storage should be limited to stockpile heights up to 3m. All other soils, with sandy clay loam textures, are of higher resilience to handling and stockpile heights up to 4m are likely to be suitable. However, the soil survey data provided in Appendix B of this document (or the other ALC surveys information) should be reviewed in detail when finalising localised handling requirements across the Scheme.

7.1.3. Soil handling should be carried out in suitable weather conditions and soils remaining in situ should be protected from construction works. Further details on these and other soil handling practices which should be implemented on site are described in the Department for Environment, Food and Rural Affairs (DEFRA) Construction Code of Practice for the Sustainable Use of Soils on Construction Sites[15]. The archived MAFF good practice guide for handling soils also provides guidance on soil handling[16].

7.1.4. Opportunities to maximise the sustainable reuse of surplus soils should first consider the condition of the soil in order to ensure their suitability for the desired end use. Proposed uses of surplus soils based on published soil data and the findings of the ALC survey are described in Section 0.

[15] Defra (2008). Construction Code of Practice for the Sustainable Use of Soils on Construction Sites. Accessed on 10th June 2021 from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/716510/pb13298-code-of-practice-090910.pdf

[16] MAFF (2000). Good practice guide for handling soils. Accessed on 10th June 2021 from https://webarchive.nationalarchives.gov.uk/20090317221756/http://www.defra.gov.uk/farm/environment/land-use/soilguid/index.htm

8. Soil reuse opportunities

8.1.1. Other than soils displaced by the new road layout and flood attenuation areas, surplus topsoil may be generated where low maintenance grassed roadside verges / embankments are proposed, as seeding directly into the subsoil proves effective in creating this landscape, and is a key initiative identified by Highways England in creating biodiversity[17].

8.1.2. Beneficial reuse of soil should be prioritised over general fill or removal as waste, as this is the most sustainable approach and results in financial benefits. Examples of sustainable reuse include using surplus soil to improve land returning to agriculture, creating new habitats of increased biodiversity, selling to nearby companies or donating to interested organisations.

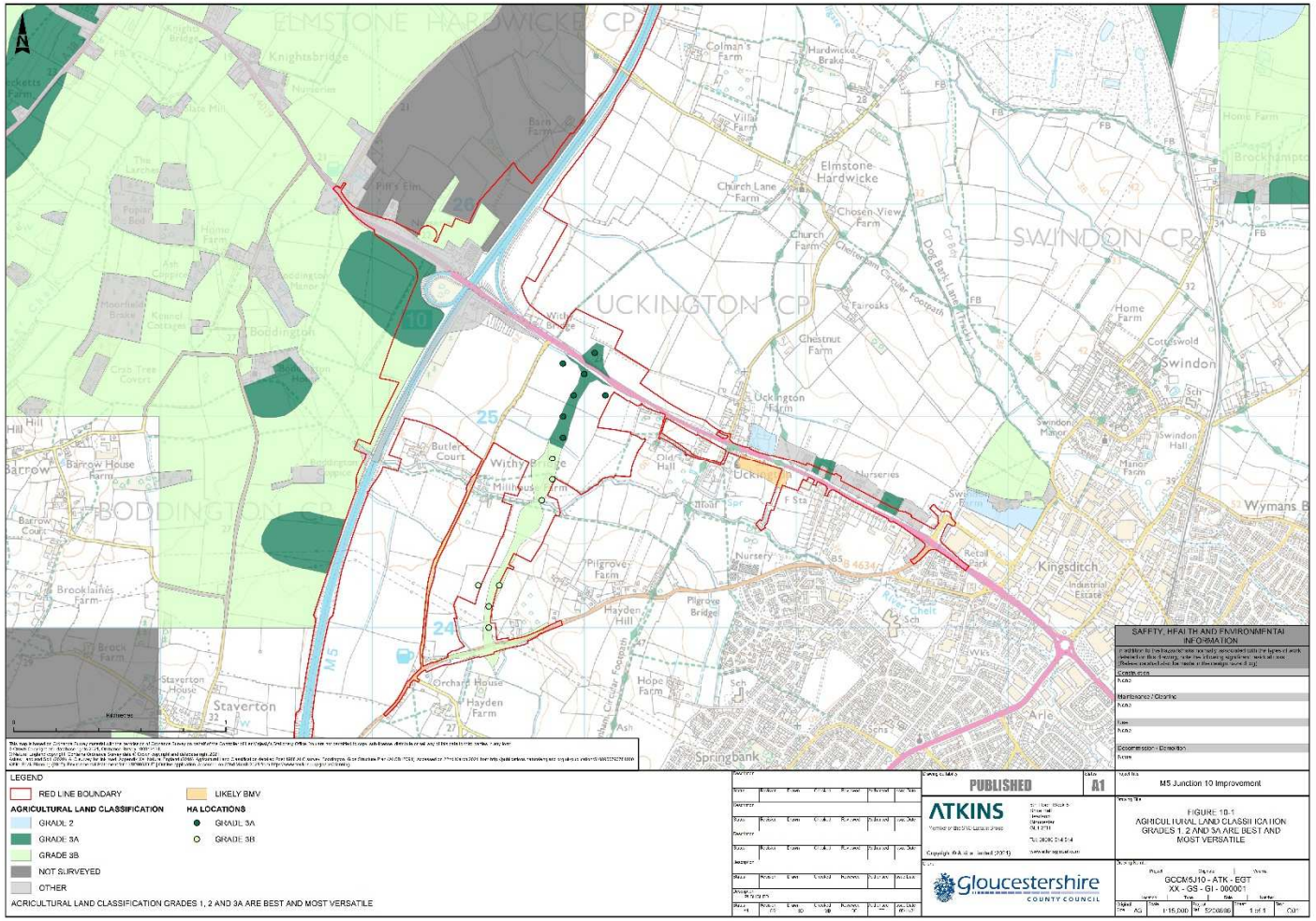
8.1.3. If design requires, calcareous grassland could be created using surplus subsoil generated in the south of the link road survey area but further investigation would be required in the calcium content as the field test utilised in the ALC survey is indicative only. Neutral grassland could be created from surplus soils elsewhere on the Scheme.

[17] Highways England (2020). Press release: Breaking new ground with eco drive to bring the country's verges to life. Accessed on 10th June 2021 from https://www.gov.uk/government/news/breaking-new-ground-with-eco-drive-to-bring-the-countrys-verges-to-life

Appendices to the Agricultural Land Classification survey

- Appendix A - ALC grades
- Appendix B - Soil profiles
- Appendix C - Laboratory analysis

Appendix A. ALC Grades



Appendix B. Soil Profiles

ASKEW LAND+SOIL

Project Number	Project Name	Parcel
C759	Atkins: J10 M5 Gloucestershire	

Date of Survey	Survey Type	Surveyor(s)	Company
10 & 11 Dec 2020	Detailed ALC	RWA & LG	Askew Land and Soil

Weather	Relief	Land use and vegetation
Cold, cloudy, dry	Gently undulated betwee 26m - 28m	LEY (Ley Grass)

Grid Reference	Postcode	Altitude	Area
SO908246	GL51 0SW	27	19

MAFF prov	MAFF detailed	Flooding
All Grade	No Post 1988 at site; MAFF 3a and 3b to west	Flood Zones 2 and 3

AAR	AT0	MDw	MDp	FCD	Climate grade
627	1489	113	107	139	1

Bedrock	Superficial deposits
Charmouth Mudstone Formation	Cheltenham Sand And Gravel and Alluvium in north

Soil association(s) 1:250,000	Detailed soil information
Badsey 2; Fladbury; Evesham 2	No SSEW 1:25K soil map

Revision Number	Date Revised
2	21/12/2020

Point	Grid ref. NGR	X	Y	Alt (m)	Slope °	Aspect	Land use	Depth (cm) Top	Bttm	Thick	Matrix Munsell colour	Ochreous Mottles Form	Munsell colour	Grey Mottles Form	Munsell colour	Gley	Texture	Stones - type 1 %	> 2cm	> 6cm	Type	Stones - type 2 %	> 2cm	> 6cm	Type	Ped Strength	Size	Shape	SUBS STR	CaCO3	Mn C	SPL	Drought MBw	MBp	Gd	Wet WiC	Gw	Final ALC Limitation 1	Limitation 2	Limitation 3	Grade	Profile notes
1	SO 91050	25300	391050	225300	28	<7°	South	LEY	0	19	19	2.5Y4/4					No	SCL - Sandy	4	2	0	GH - Gravel with non-porous (hard) stones							Not Applic	SC - Slight	No	No	-5	-11	3a	WiC I	1	Droughtiness			3a	Surveyed by Lucy Gilbert on 11th December 2020
									19	32	13	2.5Y4/4					No	SCL - Sandy	4			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	No	No										
									32	60	28	2.5Y4/2	MD - h7.5YR4/6				No	SC - Sand	4			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	No	No										
									60	120	60	2.5Y6/6	MD - h7.5YR4/6				No	SC - Sand	70			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	No	No										
2	SO 90900	25250	390900	225250	26	<7°	South	LEY	0	33	33	2.5Y4/2					No	SCL - Sandy	4	2	0	GH - Gravel with non-porous (hard) stones							Not Applic	SC - Slight	No	No	-3	-8	3a	WiC I	1	Droughtiness			3a	
									33	62	29	2.5Y5/4	FF - Fe7.5YR4/6				No	SCL - Sandy	8			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	No	No										
									62	120	58	2.5Y6/2	FD - Fe7.5YR4/6				Yes	SC - Sand	70			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	Yes	No										
3	SO 91000	25200	391000	225200	27	<7°	South	LEY	0	34	34	2.5Y3/2					No	SCL - Sandy	6	2	0	GH - Gravel with non-porous (hard) stones							Not Applic	SC - Slight	No	No	-6	-12	3a	WiC I	1	Droughtiness			3a	
									34	58	24	2.5Y5/4	FF - Fe7.5YR4/6				No	SCL - Sandy	8			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	No	No										
									58	120	62	2.5Y6/2	CD - Cz7.5YR4/6				Yes	SC - Sand	70			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	Yes	No										
4	SO 91100	25100	391100	225100	27	<7°	South	LEY	0	32	32	2.5Y4/3					No	SCL - Sandy	6	1	0	GH - Gravel with non-porous (hard) stones							Not Applic	SC - Slight	No	No	-6	-12	3a	WiC I	1	Droughtiness			3a	
									32	58	26	2.5Y5/4	FF - Fe7.5YR4/6				No	SCL - Sandy	8			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	No	No										
									58	120	62	2.5Y6/2	CD - Cz7.5YR4/6				Yes	SC - Sand	70			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	Yes	No										
5	SO 90950	25100	390950	225100	27	<7°	South	LEY	0	32	32	2.5Y4/2					No	SCL - Sandy	6	2	0	GH - Gravel with non-porous (hard) stones							Not Applic	SC - Slight	No	No	-6	-12	3a	WiC I	1	Droughtiness			3a	
									32	58	26	2.5Y5/4	FF - Fe7.5YR4/6				No	SCL - Sandy	8			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	No	No										
									58	120	62	2.5Y6/2	CD - Cz7.5YR4/6				Yes	SC - Sand	70			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	Yes	No										
6	SO 90900	25000	390900	225000	27	<7°	South	LEY	0	33	33	2.5Y3/2					No	SCL - Sandy	2	1	0	GH - Gravel with non-porous (hard) stones							Not Applic	vSC - Wet	No	No	2	-3	3a	WiC II	2	Droughtiness			3a	
									33	65	32	2.5Y5/4	CD - Cz7.5YR4/6				Yes	SCL - Sandy	4			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	No	No										
									65	120	55	2.5Y6/2	CD - Cz7.5YR4/6				Yes	SC - Sand	70			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	Yes	No										
7	SO 90900	24900	390900	224900	28	<7°	South	LEY	0	25	25	2.5Y4/3					No	C - Clay	4	2	0	GH - Gravel with non-porous (hard) stones							Not Applic	vSC - Wet	No	No	-1	1	3a	WiC I	3a	Droughtiness Wetness			3a	
									25	70	45	2.5Y5/3	FD - Fe7.5YR4/6				Yes	C - Clay	8			GH - Gravel with non-porous (hard) stones							Moderate	SC - Slight	No	No										
									70	120	50	2.5Y6/2	CD - Cz7.5YR4/6				Yes	SC - Sand	70			GH - Gravel with non-porous (hard) stones							Moderate	MC - Mod	Yes	No										
8	SO 90850	24800	390850	224800	27	<7°	South	LEY	0	24	24	2.5Y5/3					No	C - Clay	0										Not Applic	NON - Wet	No	No	17	0	2	WiC III	3b	Wetness			3b	
									24	45	21	2.5Y5/3	CD - Cz7.5YR4/6				Yes	C - Clay	0										Moderate	NON - Wet	No	No										
									45	84	39	2.5Y5/6	MP - h7.5YR4/6				Yes	C - Clay	0										Poor	NON - Wet	Yes	Yes										
									84	120	36	2.5Y6/2	MP - h7.5YR4/6				Yes	C - Clay	0										Poor	NON - Wet	Yes	Yes										
9	SO 90850	24700	390850	224700	27	<7°	South	LEY	0	24	24	2.5Y5/3					No	C - Clay	0										Not Applic	NON - Wet	No	No	11	-6	2	WiC IV	3b	Wetness			3b	
									24	45	21	2.5Y5/6	MP - h7.5YR4/6				Yes	C - Clay	0										Poor	NON - Wet	Yes	Yes										
									45	120	75	2.5Y6/2	MP - h7.5YR4/6				Yes	C - Clay	0										Poor	NON - Wet	Yes	Yes										
10	SO 90800	24600	390800	224600	27	<7°	South	LEY	0	26	26	2.5Y4/4					No	C - Clay	0										Not Applic	NON - Wet	No	No	11	-6	2	WiC IV	3b	Wetness			3b	
									26	50	24	2.5Y5/3	CD - Cz7.5YR4/6				Yes	C - Clay	0										Poor	NON - Wet	No	Yes										
									50	120	70	2.5Y6/2	CD - Cz7.5YR4/6				Yes	C - Clay	0										Poor	NON - Wet	No	Yes										
11	SO 90800	24500	390800	224500	28	<7°	South	LEY																																		No access on 10/12/2020
12	SO 90700	24500	390700	224500	27	<7°	South	LEY																																		No access on 10/12/2020
13	SO 90700	24400	390700	224400	28	<7°	South	LEY																																		No access on 10/12/2020

Point	Grid ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Pad			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC				Profile notes
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade	
14	SO 90650 24300	390650	224300	28	<7°	South	LEY																																	No access on 10/12/2020
15	SO 90600 24200	390600	224200	27	<7°	South	LEY	0 15 28	15 28 120	15 13 92	2.5Y4/3 5Y4/2 5Y5/3		 MD - h7.5YR4/6 MD - h7.5YR4/6		 MD - h2.5Y5/2 MD - h2.5Y5/2	No Yes Yes	C - Clay C - Clay C - Clay	0 0 0											Not Applic Moderate Poor	NON - F SC - Slig MC - M	No No No	No No Yes	11	-6	2	WC IV	3b	Wetness			3b	
16	SO 90500 24200	390500	224200	26	<7°	South	LEY	0 16 50	16 50 120	16 34 70	2.5Y4/3 2.5Y5/3 5Y5/3					No Yes Yes	C - Clay C - Clay C - Clay	0 0 0											Not Applic Moderate Poor	VSC - W SC - Slig MC - M	No No Yes	No No Yes	18	1	2	WC III	3b	Wetness			3b	
17	SO 90550 24100	390550	224100	27	<7°	South	LEY	0 15 45 60	15 45 60 120	15 30 15 60	2.5Y4/4 2.5Y5/3 5Y4/3 5Y5/3					No Yes Yes Yes	C - Clay C - Clay C - Clay C - Clay	0 0 0 0											Not Applic Moderate Poor Poor	VSC - W SC - Slig SC - Slig MC - M	No No Yes Yes	No No Yes Yes	16	-1	2	WC III	3b	Wetness			3b	
18	SO 90550 24000	390550	224000	27	<7°	South	LEY	0 18 45 60	18 45 60 120	18 27 15 60	2.5Y4/3 2.5Y5/3 5Y4/3 5Y5/3					No Yes Yes Yes	C - Clay C - Clay C - Clay C - Clay	0 0 0 0											Not Applic Moderate Moderate Poor	VSC - W SC - Slig SC - Slig MC - M	No No No Yes	No No No Yes	19	4	2	WC III	3b	Wetness			3b	
19	SO 90550 23850	390550	223850	28	<7°	South	LEY																																	No access on 10/12/2020
	END																																							

ASKEW LAND+SOIL

Mottle form
FF - Few Faint
FD - Few Distinct
FP - Few Prominent
CF - Common Faint
CD - Common Distinct
CP - Common Prominent
MF - Many Faint
MD - Many Distinct
MP - Many Prominent
VF - Very many Faint
VD - Very many Distinct
VP - Very many Prominent

Texture
C - Clay
CHK - Chalk
CS - Coarse Sand
CSL - Coarse sandy loam
CSZL - Coarse sandy silt loam
FP - Fibrous and semifibrous peats
FS - Fine Sand
FSL - Fine sandy loam
FSZL - Fine sandy silt loam
HCL - Clay loam (heavy)
HP - Humified peats
HZCL - Silty clay loam (heavy)
IMP - Impenetrable to roots
LCS - Loamy Coarse Sand
LFS - Loamy fine sand
LMS - Loamy medium sand
LP - Loamy peats
MCL - Clay loam (medium)
MS - Medium Sand
MSL - Medium sandy loam
MSZL - Medium sandy silt loam
MZ - Marine Light Silts
MZCL - Silty clay loam (medium)
OC - Organic clays
OL - Organic loams
OS - Organic sands
PL - Peaty loams
PS - Peaty sands
SC - Sandy clay
SCL - Sandy clay loam
SP - Sandy peats
ZC - Silty clay
ZL - Silt loam

Stone Type
CH - Chalk or chalk stones
FSST - Soft fine grained sandstones
GH - Gravel with non-porous (hard) stones
GS - Gravel with porous stones (mainly soft stone types listed above)
HR - All hard rocks or stones (i.e. those which cannot be scratched with a finger nail)
MSST - Soft, medium or coarse grained sandstones
SI - Soft 'weathered' igneous or metamorphic rocks or stones
SLST - Soft oolitic or dolomitic limestones
ZR - Soft, argillaceous or silty rocks or stones

Ped. Shape
SG - Single grain
GRA - Granular
SAB - Subangular Blocky
AB - Angular Blocky
PRIS - Prismatic
PLAT - Platy
MASS - Massive
NA - N/A

Subsoil Structure Condition
Not Applicable
Good
Moderate
Poor

Soil or Ped. Strength
Loose
Very friable
Friable
Firm
Very firm
Extremely firm
Extremely hard
N/A

Calcareousness
NON - Non-calcareous (<0.5% CaCO3)
VSC - Very slightly calcareous (0.5 - 1% CaCO3)
SC - Slightly calcareous (1 - 5% CaCO3)
MC - Moderately calcareous (5 - 10% CaCO3)
VC - Very calcareous (>10% CaCO3)

Ped. Size
VF - Very Fine
F - Fine
M - Medium
C - Coarse
VC - Very Coarse
NA - N/A

Degree of Ped. Development
W - Weak
M - Moderate
S - Strong
NA - Not applicable

Wetness Class
WC I
WC II
WC III
WC IV
WC V
WC VI

ALC Grades
1
2
3a
3b
4
5
Non-Ag

Gley
None
Gley
N/A

Appendix C. Laboratory Analysis

ANALYTICAL REPORT

Report Number	34370-20	N717	ROB ASKEW
Date Received	14-DEC-2020		RW ASKEW
Date Reported	21-DEC-2020		THE OLD STABLES
Project	SOIL		UPEXE
Reference	C759 J10 M5		EXETER
Order Number			DEVON EX5 5ND

Laboratory Reference		SOIL499763	SOIL499764	SOIL499765
Sample Reference		AB5	AB10	AB18
Determinand	**Unit**	**SOIL**	**SOIL**	**SOIL**
Sand 2.00-0.063mm	% w/w	57	29	24
Silt 0.063-0.002mm	% w/w	17	36	24
Clay <0.002mm	% w/w	26	35	52
Textural Class **		SCL	C/HCL	C

Notes

Analysis Notes: The sample submitted was of adequate size to complete all analysis requested.
The results as reported relate only to the item(s) submitted for testing.
The results are presented on a dry matter basis unless otherwise stipulated.

Document Control: **This test report shall not be reproduced, except in full, without the written approval of the laboratory.**

** Please see the attached document for the definition of textural classes.

Reported by: *Myles Nicholson*

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Technical Information

ADAS (UK) Textural Class Abbreviations

The texture classes are denoted by the following abbreviations:

Class	Code
Sand	S
Loamy sand	LS
Sandy loam	SL
Sandy Silt loam	SZL
Silt loam	ZL
Sandy clay loam	SCL
Clay loam	CL
Silt clay loam	ZCL
Clay	C
Silty clay	ZC
Sandy clay	SC

For the *sand, loamy sand, sandy loam* and *sandy silt loam* classes the predominant size of sand fraction may be indicated by the use of prefixes, thus:

- vf Very Fine (more than 2/3's of sand less than 0.106 mm)
- f Fine (more than 2/3's of sand less than 0.212 mm)
- c Coarse (more than 1/3 of sand greater than 0.6 mm)
- m Medium (less than 2/3's fine sand and less than 1/3 coarse sand).

The subdivisions of *clay loam* and *silty clay loam classes* according to clay content are indicated as follows:

- M medium (less than 27% clay)
- H heavy (27-35% clay)

Organic soils i.e. those with an organic matter greater than 10% will be preceded with a letter O.

Peaty soils i.e. those with an organic matter greater than 20% will be preceded with a letter P.

For further information on all analyses and services available from NRM Laboratories contact us on:
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