M42 Junction 6 Improvement
Scheme Number TR010027
Volume 6
6.1 Environmental Statement
Chapter 10 – Geology and Soils

Regulation 5(2)(a)

Planning Act 2008

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

January 2019

Infrastructure Planning

Planning Act 2008

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

M42 Junction 6 Improvement Development Consent Order 202[ ]

6.1 Environmental Statement
Chapter 10 – Geology and Soils

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10 Geology and soils

10.1 Competent expert evidence

10.1.1 This chapter presents the results of an assessment of the likely significant effects of the Scheme on geology and soils; geology and soils is a collective term used to describe the geological and soils setting and features including land contamination.

10.1.2 The competent expert responsible for the assessment is an Associate Director within AECOM who is a Chartered Environmentalist and Chartered Scientist, and a full member of the Institute of Environmental Science (MIEnvSc).

10.1.3 They have 22 years of experience of assessment and remediation of contaminated land. They have provided technical expertise and input into contaminated land, waste management and geology and soils assessments within environmental impact assessments (EIA) for large linear transportation infrastructure projects.

10.2 Legislative and policy framework

10.2.1 The following legislation, planning policy and guidance documents are of direct relevance to the assessment of effects of the Scheme on geology and soils is presented in the sections below, as well as the European Union (EU) Directives relevant to the Scheme.

10.2.2 Compliance with statute and policy relating to geology, soils and contaminated land is addressed within the Planning Statement [**TR010027/APP/7.1**].

National Policy Statement for National Networks

10.2.3 The National Policy Statement for National Networks (NPSNN) [REF 10-1] acknowledges that the construction and operation of road and rail infrastructure has the potential to affect geology and soils, and provides guidance on the identification, assessment and mitigation of effects on geology and soils.

10.2.4 Paragraph 5.168 of the NPSNN [REF 10-1] describes the requirement to take into account the economic and other benefits of the best and most versatile (BMV) agricultural land (defined as land in grades 1, 2 and 3a of the Agricultural Land Classification [REF 10-2]) and where possible poorer quality land in preference to that of a higher quality should be taken. Paragraph 5.168 of the NPSNN [REF 10-1] also describes the requirement to seek to minimise impacts, on soil quality and citing, where possible, developments should be on previously developed (brownfield) sites provided that it is not of high environmental value.

10.2.5 With regard to the potential for land contamination associated with former or current land uses (brownfield sites) the NPSNN [REF 10-1] states that for developments on previously developed land, the risk posed by land contamination and how it is mitigated is required.

10.2.6 Paragraph 5.169 of the NPSNN [REF 10-1] states that any mineral resources should be safeguarded as far as possible.

10.2.7 The requirements of the NPSNN [REF 10-1] in relation to identifying agricultural land or mineral resource assets and potential land contamination and then assessing and mitigating the effects of the Scheme on such assets and potential land constraints have been taken account of in this assessment. This process identifies the likely significant effects that the Secretary of State for Transport (SoS) needs to give due regard to in their decision-making.

National Planning Policy

10.2.8 National planning policy is established within the National Planning Policy Framework (NPPF) [REF 10-3].

10.2.9 In relation to making effective use of land, paragraph 118 of the NPPF [REF 10-3] identifies that planning decisions should recognise that some undeveloped land can perform many functions, and that substantial weight should be given to the value of using suitable brownfield land (including supporting appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land.

10.2.10 In relation to conserving and enhancing the natural environment, paragraph 170 states that: "*Planning policies and decisions should contribute to and enhance the natural and local environment by*:

> *(a) protecting and enhancing… sites of… geological value and soils…;*
> *(b) recognising… the economic and other benefits of the best and most versatile agricultural land;*
> *(e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability; and*
> *(f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate*."

10.2.11 Further regard to agricultural land is given in paragraph 171, which acknowledges that where significant development of agricultural land is demonstrated to be necessary, areas of poorer quality land should be preferred to those of a higher quality.

10.2.12 In relation to ground conditions and pollution, paragraph 178 states that: *"Planning policies and decisions should ensure that:*

> (a) *a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);*
> *(b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
> *(c) adequate site investigation information, prepared by a competent person, is available to inform these assessments."*

The Environmental Protection Act 1990 and Part 2A (the Contaminated Land Regime)

10.2.13 Current legislation relating to contaminated land in the UK is contained within Part 2A of The Environmental Protection Act [REF 10-4] (EPA), which was inserted by s57 of the Environment Act 1995 [REF 10-5] and by s86 of the Water Act 2003 [REF 10-6], and elaborated upon within the Contaminated Land (England) Regulations 2006 [S.I. 2006/1380] [REF 10-7] (as amended).

10.2.14 Under Part 2A [REF 10-4], sites are identified as 'contaminated land' if they are: causing harm, if there is a significant possibility of significant harm, or if the site is causing, or could cause, pollution of controlled waters (i.e. both surface and groundwater).

The Water Act 2003

10.2.15 The Water Act 2003 [REF 10-6] introduced a revision to the wording of the EPA, which requires that if a site is causing or could cause significant pollution of controlled waters, it may be determined as contaminated land. Once a site is determined to be contaminated land then remediation is required to render significant pollutant linkages insignificant (i.e. the source-pathway-receptor relationships that are associated with significant harm to human health and/or significant pollution of controlled waters), subject to a test of reasonableness.

The Water Resources Act 1991

10.2.16 The Water Resources Act 1991 [REF 10-8] provides statutory protection for controlled waters (i.e. streams, rivers, canals, marine environment and groundwater) and makes it an offence to discharge to controlled waters without the permission or consent of the regulators of these areas.

The Building Act 1984 and the Building Regulations & c (Amendment) Regulations 2016

10.2.17 The Building Act 1984 and in particular the associated Building Regulations & c (Amendment) Regulations 2016 [REF 10-9] are key when considering structural and design aspects of a development in terms of the geotechnical properties of the ground.

10.2.18 The Building Act 1984 [REF 10-10] requires that buildings are constructed so that ground movement caused by swelling, shrinkage, freezing, landslip or subsidence of the sub-soils will not impair the stability of any part of the building.

10.2.19 Both pieces of legislation [REF 10-9]; [REF 10-10] are key when considering the structural and design aspects of a development.

The Town and Country Planning (Development Management Procedure) (England) Order 2015

10.2.20 The Town and Country Planning (Development Management Procedure) (England) Order 2015 [REF 10-11] requires that Natural England must be consulted on development which is not for agricultural purposes and is not in accordance with the provisions of a development plan, and which involves:

a. the loss of not less than 20ha of grades 1, 2, 3 or 3a agricultural land, which for the time being used (or was last used) for agricultural purposes; or

b. the loss of less than 20ha of grades 1, 2, or 3a agricultural land which is for the time being used (or was last used) for agricultural purposes, in circumstances which the development is likely to lead to a further loss of agricultural land amounting cumulatively to 20ha or more.

Other legislation

10.2.21 Other EU Directives and legislation of relevance to this assessment includes:

c. Environmental Permitting (England and Wales) Regulations 2016 [REF 10-12];

d. Hazardous Waste (England and Wales) (Amendment) Regulations 2016 [REF. 10-13];

e. Contaminated Land (England) (Amendment) Regulations 2012 [REF 10-7];

f. Environmental Damage (Prevention and Remediation) Regulations 2009 [REF 10-14];

g. Anti-Pollution Works Regulations 1999 [REF 10-15];

h. The Water Framework Directive (2000/60/EC) [REF 10-16];

i. The Groundwater Directive (2006/118/EC) [REF 10-17];

j. The Environmental Quality Standards (EQS) Directive (2008/105/EC) [REF 10-18]; and

k. The Environmental Liability Directive (2004/35/EC) [REF 10-19].

Warwickshire Minerals Plan

10.2.22 The Warwickshire Minerals Plan Publication Consultation (December 2016) [REF 10-20] contains the following policies relevant to this assessment:

a. Policy MCS 5: Safeguarding of Minerals and Minerals Infrastructure states that Mineral resources of local and national importance within the Mineral Safeguarding Areas will be safeguarded from needless sterilisation by non-mineral development. Non-mineral development, Mineral Safeguarding Areas if they would constrain or hinder existing or future mineral development.

b. Policy DM10: Non-mineral development within the Minerals Safeguarding Areas should not proceed unless the proposals for non-mineral development in the vicinity of permitted mineral sites or mineral site allocations would not unduly restrict the mineral operations; or

c. the prospective developer has produced evidence prior to the determination of the planning application that clearly demonstrates that the mineral concerned is no longer of any value, or potential value; or

d. It can be clearly demonstrated that the mineral can be extracted prior to the development taking place; or

e. the non-mineral development is of a temporary nature and can be completed and the site restored before the mineral needs to be extracted; or

f. the development is of a minor nature which would not constrain or hinder the extraction of the mineral resource; or

g. there is an overriding need for the non-mineral development.

Solihull Local Plan: Shaping a Sustainable Future

10.2.23 The Solihull Local Plan [REF 10-21], contains the following policies relevant to this assessment :

a. Policy P10: Natural Environment indicates that development with potential to have adverse effect on a Site of Special Scientific Interest (SSSI) or geological sites whether directly or indirectly, will be subject to special scrutiny and will be permitted only if the reasons for the development clearly outweigh the nature conservation value of the site and the national policy to safeguard such sites. Where development may have an adverse effect on a SSSI, developers will be expected to incorporate measures to enhance the condition of the site, unless it is demonstrated that it is not feasible;

b. Policy P11: Water Management indicates that the Council expects developers to undertake thorough risk assessments of the impacts of proposals on surface and groundwater systems and incorporate appropriate mitigation measures where necessary;

c. Policy 13: Minerals indicates that the Mineral Safeguarding Areas for important underground coal resources in the eastern part of the Borough, and for sand and gravel aggregate resources between Berkswell, Hampton and Meriden and east of the National Exhibition Centre (NEC) and M42, including sites for important associated infrastructure and to meet potential needs are defined on the associated Proposals Map; and

d. Policy P17: Countryside and Greenbelt states that the Council will safeguard the “best and most versatile” agricultural land in the Borough and encourage the use of the remaining land for farming. Development affecting the “best and most versatile” land will be permitted only if there is an overriding need for the development or new use, and there is insufficient lower grade land available, or available lower grade land has an environmental significance that outweighs the agricultural considerations, or the use of lower grade land would be inconsistent with other sustainability considerations.

10.2.24 Solihull Metropolitan Borough Council (SMBC) is currently undertaking a review of the Solihull Local Plan [REF 10-21]. The draft of the Local Plan Review (November 2016) [REF 10-22] has been submitted for consultation, with the final to be adopted in summer 2019. However, a review of the draft document indicates that there are no significant changes to the Solihull Local Plan [REF 10-21] with respect to this assessment.

10.2.25 The national and local policies discussed in this section have been considered during the preparation of baseline information, when undertaking assessments, informing the design-development process (see Chapter 4 Scheme history and alternatives) and when identifying mitigation measures.

10.3 Assessment methodology

Scope of the assessment

10.3.1 A scoping exercise was undertaken in late 2017 to identify the matters to be covered by the geology and soils assessment and agree the approach with relevant statutory bodies.

10.3.2 The assessment scope was established by comparing the preliminary design and land take details for the Scheme with available data, information and records relating to contamination (historical and present), underlying geology and applicable historic land uses.

10.3.3 The scoping exercise concluded the need to focus the assessment on the following receptors:

a. human health: off-site receptors;

b. human health: future site users;

c. controlled waters groundwater and surface waters; and

d. surrounding land uses: agricultural land and soil quality.

10.3.4 Whereby the following impacts and effects may be generated by the Scheme:

a. physical impacts of the Scheme: such as, changes in topography, soil compaction, soil erosion, ground stability;

b. impacts associated with re-use of soils and waste soils: re-use of site-sourced materials on- or off-site, disposal of site sourced materials off-site and/or importation of materials to the site;

c. impact on soils as a valuable resource: for example, loss or damage to soils of good agricultural quality;

d. effects associated with ground contamination that may already exist on site: for example, introducing or changing pathways of contamination migration, or changes to the characteristics and contamination receptors; and

e. effects associated with the potential for polluting substances used during construction or operation to cause new ground contamination issues on site: for example the accidental loss/spillage of fuels and oils to ground.

10.3.5 The outcomes of the scoping exercise were recorded in a scoping report [REF 10-23], which was consulted upon as part of a formal request to the Planning Inspectorate (the Inspectorate) for a scoping opinion. The scoping report [REF 10-23] included a summary of all assessment work undertaken as part of the design-development of the Scheme up to the point of its publication.

10.3.6 The Inspectorate's scoping opinion [REF 10-24] identified a number of additional overarching EIA and topic-specific matters that were subsequently brought into the overall scope of the assessment. These further considerations are detailed in Appendix 5.3 [**TR010027/APP/6.3**] and include a summary of how Highways England has responded to the points raised, and where the relevant information is presented within this chapter and elsewhere in the Environmental Statement.

10.3.7 In addition to the matters raised in the scoping opinion [REF 10-24] the final assessment scope has also been shaped by the following:

a. the outcomes of consultation with statutory bodies, non-statutory organisations and other stakeholders (where applicable) with an interest in geology and soils;

b. design changes made to the Scheme in respect of its form and extent, and the area of land required for its construction and operation; and

c. the outcomes of field surveys undertaken to establish the baseline conditions of the water environment.

10.3.8 Consideration was given to the activities associated with the future maintenance and management of the Scheme, and whether these have the potential to result in significant effects on receptors considered in the assessment of geology and soils. Following a review of the maintenance activities presented in Chapter 3 The project, the process concluded that potential exists for workers responsible for undertaking future maintenance activities on the Scheme to be exposed to, or affected by, contamination. Accordingly, the assessment of operational effects has considered the potential for significant effects to occur on maintenance workers.

Assessment guidance

10.3.9 The following guidance has been used to inform the scope and content of the assessment, and to assist the identification and mitigation of likely significant effects. This builds upon the overarching EIA methodology and guidance presented in Chapter 5 EIA methodology and consultation.

10.3.10 Guidance contained in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 11 – Geology and Soils [REF 10-25] has been used to define the assessment framework. Although this does not provide formal guidance on the assessment of impacts and the significance of effects, its methodologies have been further developed by the project team.

10.3.11 The impact assessment methodology applied takes account of technical guidance that has been produced in the UK for the assessment of ground conditions and water resources by: the government (i.e. DEFRA and its predecessor and successor departments); agencies such as the Environment Agency (EA) and Contaminated Land: Applications in Real Environments (CL:AIRE); and relevant British Standards.

10.3.12 The methodology applied considers the potential presence of land and groundwater contamination, sites of geological/geomorphological significance (such as geological conservation features or mineral resources), controlled waters, the built environment, human receptors and the presence of agricultural land/soils. Geotechnical constraints such as differential settlement, subsidence and the potential for explosive ground gas accumulation have also been considered where relevant (with the built environment identified as the main receptor including foundations, below ground structures, utilities equipment and any proposed buildings associated with the Scheme).

10.3.13 The impacts associated with land contamination are generally assessed by means of a source/hazard-pathway-receptor methodology and the production of a conceptual site model (CSM). The relevant sources pathways and receptors have been identified as part of the baseline conditions. This methodology is consistent with the risk-based framework adopted in the EA document 'Model Procedures for the Management of Land Contamination – CLR11' [REF 10-26]. Guidance within BS10175: 2011+A2:2017 'Investigation of Potentially Contaminated Sites – Code of Practice' [REF 10-27] is also followed.

10.3.14 For contamination to result in a potential impact considered significant, it must be demonstrated that there is an identifiable source of contamination (be it an on-site or off-site source), potential sensitive receptors and potential pathways through which the former may affect the latter. The assessment has considered both the impacts of existing contamination on the Scheme, and the potential for the Scheme to impact upon land quality.

10.3.15 The assessment of impact to agricultural soils has been undertaken in accordance with the guidance within DMRB Volume 11, Section 3, Part 6 – Land Use – Amendment No 1 [REF 10-28], in particular sections 7 and 10 of the guidance which cover agricultural land quality agricultural land classification (ALC). Impacts in relation to loss of ALC land has been assessed within this chapter.

10.3.16 With regard to impacts upon agricultural soils, the assessment methodology has taken into account the statutory consultation procedures in the Town and Country Planning (Development Management Procedure) (England) Order 2015 [REF 10-10] in which Natural England has to consider proposals which individually or cumulatively involve the loss of more than 20ha of BMV land.

10.3.17 Where necessary, risks to flora and fauna have been assessed in line with current EA guidance, including Guidance on the Use of Soil Screening Values in Ecological Risk Assessment [REF 10-29] and additional information provided in BS3882:2015 Specification for Topsoil [REF 10-30].

Establishment of the baseline conditions

10.3.18 Establishment of the baseline environment has involved reference to existing data sources, consultation with statutory bodies and other organisations, and fieldwork surveys.

Desk studies

10.3.19 Information has been obtained from the following organisations:

a. British Geological Survey (BGS) [REF 10-31];
b. Department for Environment, Food and Rural Affairs (DEFRA) [REF 10-32];
c. EA [REF 10-33];
d. Envirocheck Ltd [REF 10-34];
e. Natural England [REF 10-35];
f. SMBC [REF 10-36];
g. Warwickshire County Council [REF 10-37]; and
h. Warwickshire Geological Conservation Group (WGCG) [REF 10-38].

10.3.20 Information was also obtained from the following surveys:

a. Geo-environmental and geotechnical Site Walkover information [undertaken by AECOM on 14 to 15 September 2017 in support of proposed ground investigation; and
b. AECOM Ground Investigation Report 2018 [REF 10-39].

10.3.21 The Landmark Envirocheck Report [REF 10-40] obtained for the site provides environmental data covering potential sources of contamination, previous industrial land use and sensitive land uses.

10.3.22 Information obtained from historical factual and interpretative geotechnical and geo-environmental reports (relating to site investigations), soil surveys and ALC surveys have been reviewed and reported as applicable in this assessment. The previous ground investigation data and review has been taken from the Preliminary Sources Study Report (PSSR) [REF 10-41] which included a review of previous ground investigation works to date.

10.3.23 Additional Geo-environmental baseline has also been collected, comprising a review of a number of reports previously undertaken in the area of the Scheme.

Physical surveys

10.3.24 An intrusive ground investigation undertaken between January and June 2018 has been completed to obtain details of prevailing ground conditions and to assess the potential constraints associated with geology and soils. The findings of the main phase of the ground investigation are detailed in a Ground Investigation Report [REF 10-39].

10.3.25 An ALC assessment survey was undertaken over 9 and 10 October 2018 to investigate the ALC and soil resources of land potentially affected by the Scheme. The ALC survey classified agricultural land by grade to enable the identification of any BMV land within the geology study area (see Section 10.5). The results of the survey are detailed in the Agricultural Land Classification Report in Appendix 10.2 [**TR010027/APP/6.3**].

Sensitivity of the receptor

10.3.26 The sensitivity of a geology or soil receptor has been established through the identification and evaluation of the susceptibility of the receptors ability to changes arising from the Scheme, and the value attached to these.

10.3.27 Susceptibility relates to the ability of geology or soil receptor to accommodate change without undue consequences.

10.3.28 The sensitive receptors include:

a. receptors susceptible to land contamination and ground hazard impacts (e.g. human, ecological, hydrological receptors);

b. soil and geological resources (e.g. international, national or regionally designated sites, soils of high nature conservation or landscape importance, mineral reserves, demand on waste management infrastructure through disposal of soils); and

c. agricultural soil resources (e.g. high quality ALC Grade 1 soils).

10.3.29 The overall importance/sensitivity of these receptors is ranked from high to very low based on such variables as distance from the Scheme, quality of the receptor or its value as a resource. The descriptive scale for the importance/sensitivity of receptors is presented in **Table 10.1.**

Table 10.1: Criteria for sensitivity

Importance/ sensitivity	Criteria	Receptors susceptible to land contamination and ground hazard impacts	Soil and geological resources	Agricultural soil resources
High	Attribute has a high quality and rarity on regional or national scale or high sensitivity.	Future site users – residential development. Residential areas or schools within 50m of construction works Water features deemed to be of high value. Ecological features deemed to be of high value. Allotments, arable farmland, livestock or market gardens on or adjacent to the site.	Internationally and nationally designated sites. Regionally important sites with limited potential for substitution. Soils of high nature conservation or landscape importance. Presence of significant mineral reserves and within a Mineral Consultation Area. Soil/materials disposal required following earthworks resulting in a significant increase in demand on waste management infrastructure	High quality agricultural soils (Grade 1).

Importance/ sensitivity	Criteria	Receptors susceptible to land contamination and ground hazard impacts	Soil and geological resources	Agricultural soil resources
Medium	Attribute has a high quality and rarity on local scale or high sensitivity.	Future site users - commercial development. Residential areas or schools within 50 to 250m of construction works. Commercial areas within 50m of construction works. Water features deemed to be of medium value. Ecological features deemed to be of medium value. The built environment including buildings and infrastructure.	Regionally important sites with potential for substitution. Locally designated sites with limited potential for substitution. Soils of medium conservation or landscape importance. Site within a Mineral Consultation Area. Soils/materials disposal required following earthworks resulting in a moderate increase in demand on waste management infrastructure.	Good quality agricultural soils (Grade 2 and 3a).
Low	Attribute has a medium quality and rarity on local scale or medium sensitivity.	Future site users - car park, highways and railway related development. Residential areas >250m from construction works. Commercial areas within 50 to 250m of construction works. Water features deemed to be of low value Ecological features deemed to be of low value.	Undesignated sites of some local earth heritage interest. Soils of low nature conservation or landscape importance. Limited potential for mineral reserves and site not within a Mineral Consultation Area. Soil/materials disposal required following earthworks resulting in a limited increase in a minor increase in demand on waste management infrastructure.	Moderate or poor quality agricultural soils (Grade 3b and 4).
Very Low	Attribute has a low quality and rarity on local scale or medium sensitivity.	Areas where there are no built structures, crops, or livestock. Commercial areas within >250m of construction works. Water features deemed to be of low value. Ecological features deemed to be of negligible value	Other sites with little or no local earth heritage interest. Soils of negligible nature conservation or landscape importance. Negligible potential for mineral reserves to exist.	Very poor quality agricultural soils (Grade 5).

Magnitude of impact criteria

10.3.30 The magnitude of potential impacts on identified receptors, as associated with the Scheme, has been determined using the 4 point scale (very low, low, medium and high), taking into account the potential pathways through which an impact source/hazard may affect identified receptors.

10.3.31 The magnitude of impact upon features/attributes criteria are presented in **Table 10.2.**

Table 10.2: Magnitude of impact

Magnitude	Criteria	Receptors susceptible to land contamination and ground hazard impacts	Soil and geological resources	Agricultural soil resources
High	Results in loss of attribute and/ or quality and integrity of the attribute.	Human Health: Acute risk to human health. Surface waters and/or groundwater: Substantial acute pollution or long term degradation of sensitive water resources (Principal Aquifer, groundwater source protection zone, surface waters of good or very good quality). Ecology: Significant change to the number of one or more species or ecosystems. Built Environment: Catastrophic damage to buildings, structures or the environment. Landscaping/Agriculture: Loss in value of livestock or crops as a result of death, disease, or physical damage.	Loss of feature or attribute. Earthworks resulting in high volume of surplus soil for off-site disposal. Classification of surplus soil as Hazardous Waste where the intention is to discard.	Loss of over 50ha of BMV agricultural land Grades 1, 2 and 3a. Damage to/ or loss of all topsoil resource. Soil sealing >75%.
Medium	Results in effect on integrity of attribute, or loss of part of attribute.	Human Health: Chronic risk to human health. Surface water and/or groundwater: Pollution of non-sensitive water resources or small scale pollution of sensitive water resources (Principal or Secondary Aquifers of water courses of fair quality or below). Ecology: Change to population densities of non-sensitive species. Built Environment: Damage to buildings, structures or the environment. Landscaping/Agriculture: Non-permanent health effects to vegetation/crops from disease or physical damage, which results in a reduction in value.	Impact on integrity of or partial loss of feature or attribute. Earthworks resulting in moderate volume of surplus soil for off-site disposal.	Loss of between 20 and 50ha of BMV agricultural land Grades 1, 2 and 3a. Damage to/ or loss of half of topsoil resource. Soil sealing >50%.

Magnitude	Criteria	Receptors susceptible to land contamination and ground hazard impacts	Soil and geological resources	Agricultural soil resources
Low	Results in some measurable change in attributes quality or vulnerability.	Human Health: Slight reversible short-term effects to human health. Surface waters and/or groundwater: Slight pollution of non-sensitive water resources. Ecology: Some change to population densities of non-sensitive species with no negative effects on the function of the ecosystem. Built Environment: Easily reparable effects of damage to buildings or structures. Landscaping/Agriculture: Slight or short term health effects which result in slight reduction in value.	Minor impact on feature or attribute. Earthworks resulting in low volume of surplus soil for off-site disposal.	Loss of less than 20ha of BMV agricultural land Grades 1, 2 and 3a or the loss of any quantity of land not considered 'best and most versatile agricultural land' Grades 3b, 4 or 5. Re-use of all topsoil resource within the development. Soil sealing <50%.
Very Low	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.	Human Health: No measurable effects on humans. Surface waters and/or groundwater: Insubstantial pollution to non-sensitive water resource. Ecology: No significant changes to population densities in the environment or in any ecosystem. Built Environment: Very slight non-structural damage or cosmetic harm to buildings or structures. Landscaping/Agriculture: No significant reduction in landscape value.	Impact of insufficient magnitude to affect use or integrity of feature or attribute. No off-site disposal of surplus soil required	No loss of agricultural land. Minor disturbance to soils. Soil sealing unlikely to occur.

Agricultural land classification

10.3.32 The ALC system provides a method for assessing the quality of farmland and classifies land into five grades, with Grade 3 subdivided into Subgrades 3a and 3b.

10.3.33 BMV land is defined as Grades 1, 2 and 3a. This is the land which is most flexible, productive and efficient in response to inputs and which can best deliver future crops for food and non-food uses.

10.3.34 The following thresholds for loss are defined as part of the Town and Country Planning (Development Management Procedure) (England) Order 2015 [REF 10-10]:

a. High impact: loss of over 50ha of BMV agricultural land (i.e. Grades 1, 2 and 3a), damage to or loss of all topsoil and soil sealing greater 75%;

b. Medium impact: loss of between 20ha and 50ha of BMV agricultural land, damage to or loss of half of topsoil and soil sealing greater than 50%; and

c. Low impact: loss of less than 20ha BMV agricultural land, loss of any quantity of land not considered BMV, re-use of all topsoil resource within the development and soil sealing less than 50%.

Identification of likely significant effects

10.3.35 For each of the potential impacts identified, an assessment has been made of the likely level of significance of the resulting effects. The definition of effect significance has been made by taking into account both the importance/ sensitivity of the receptor and the magnitude of the predicted impact, using the matrix as presented in **Table 10.3**.

Table 10.3: Matrix to determine significance of effect

		Magnitude of impact			
		High	**Medium**	**Low**	**Very Low**
Sensitivity of resource/ receptor	**High**	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Negligible
	Low	Moderate	Minor	Negligible	Negligible
	Very Low	Minor	Negligible	Negligible	Negligible

10.3.36 The matrix has been used to guide the identification and assessment of effects on geology and soils resources; however, where professional judgement has resulted in a deviation from the thresholds contained in the matrix these are explained within the relevant sections of the chapter and are supported by appropriate evidence and explanation.

10.4 Assessment assumptions and limitations

Limits of deviation

10.4.1 The assessment has been based on the Scheme description detailed within Chapter 3 The project, and has taken into account the lateral and/or vertical limits of deviation defined on the Works Plans [**TR010027/APP/2.3**] in order to establish a realistic worst case assessment scenario.

10.4.2 This scenario has identified and reported the effect that any lateral and/or vertical deviation would realistically give rise to. This has, for example, taken into account the potential for components if the Scheme to be positioned at a slightly higher elevation, or brought into closer proximity to receptors, and thereby potentially result in a different geology or soil effect.

10.4.3 Notwithstanding any potential deviation, the geology and soils mitigation measures incorporated into the design of the Scheme, as described in Section 10.8, would still be deliverable within the limits of deviation and would still fulfil their intended function.

Warwickshire Gaelic Athletic Association

10.4.4 Using professional judgement, the illustrative reconfiguration design options for the Warwickshire Gaelic Athletic Association presented in **Figure 3.5a** to **3.5e** [**TR010027/APP/6.2**] were appraised to take account of the variation in the physical extents, pitch layout, buildings, fencing and lighting provision across the options.

10.4.5 The objective of the appraisal was to identify whether one option would potentially give rise to different effects than another, in order to then identify the worst case for the purposes of the assessment presented within this chapter.

10.4.6 The appraisal concluded that the design variation between the options would not be of a level that would result in different types or significance of effect on geological or soil based receptors.

Baseline survey data

10.4.7 The assessment undertaken in this chapter has been based on and is limited to the baseline conditions recorded at the time of undertaking field surveys.

10.4.8 An intrusive investigation designed by AECOM was undertaken by Highways England's specialist Contractor. Results are available for the ground investigation as reported in the factual report and these have been assessed as part of the Ground Investigation Report (GIR) [REF 10-39]. The assessment is based on the baseline information provided and supplemented by the interpretation of the ground investigation data available. Reliance is placed on third party data and reports within the assessment. It has been assumed that third party data is accurate and a true reflection of what it is indicating. Unless stated otherwise, AECOM has not independently verified the data presented within other consultants' reports.

10.4.9 One round of groundwater sampling and laboratory testing has been undertaken following the completion of the intrusive investigation. The assessment relating to groundwater contamination has been based on the results of the laboratory testing undertaken on this round of water samples.

10.4.10 An agricultural land classification assessment survey has been undertaken, with approximately 104ha of land surveyed across the soil sampling study area [REF 10-2].

Impact assessment and mitigation

10.4.11 As part of the ALC survey [REF 10-2] approximately 21.7ha of agricultural land was not surveyed due to site access limitations at the time of the survey. Based on the available information obtained, the areas not surveyed have been conservatively assumed as Grade 3a agricultural land for the purpose of the assessment.

10.5 Study area

10.5.1 The defined study area for this assessment includes the Scheme (defined as the area of land within the Order Limits) and an additional distance of 250m extending from the Scheme. This area is considered appropriate for the consideration of historical and current potentially contaminative land uses and it aligns with established industry practice and professional judgement for defining land contamination study areas for EIA. This area is hereinafter referred to as the 'geology study area'.

10.5.2 The exception to this is groundwater, surface water and potable water abstractions, where consideration is extended up to 500m from the Scheme (hereinafter referred to as the 'extended study area').

10.5.3 For the remainder of the topic which includes description of geography and topography and agricultural land, these are limited to the boundaries of the Scheme since these are only likely to be impacted where the Scheme directly crosses, or interfaces with them.

10.6 Baseline conditions

10.6.1 This section presents the baseline conditions for geology and soils. It also considers potential receptors that could be impacted upon by any existing or resulting ground contamination. Reference is therefore made to surface water, groundwater and ecological features in this section which are discussed in more detail in Chapter 14 Road drainage and the water environment and Chapter 9 Biodiversity. For geology and soil features, please refer to **Figure 10.1** to **10.5** [**TR010027/APP/6.2**] throughout this baseline conditions section.

Geology

10.6.2 The British Geological Survey (BGS) 1:50,000 scale solid and drift geological maps (Birmingham Sheet 168) [REF 10-42] and the BGS GeoIndex digital mapping [REF 10-43], together with information provided from previous ground investigation reports, as described within the PSSR [REF 10-41], have been used to describe the geology in the area of the Scheme. A summary of the 2018 Scheme specific ground investigation is then provided with relative commentary.

10.6.3 Based on information available prior to the 2018 ground investigation, Made Ground and superficial deposits are noted to be present within the study area. Superficial deposits are recorded to be sparse but where encountered would be anticipated to comprise alluvium, glaciofluvial and river terrace deposits. The bedrock geology underlying the study area is the Mercia Mudstone Group.

Made ground

10.6.4 The BGS GeoIndex digital mapping [REF 10-43] indicates the presence of Made Ground to the west of the M42 Junction 6, and the north of the A45 associated with Birmingham Airport and with some areas further north along the M42.

10.6.5 There are also areas of infilled ground, notably adjacent east of the Scheme, south of the A45 Coventry Road (A45), between the M42 Junction 6 and Stonebridge Island to the east, and further north near to Birmingham Business Park.

10.6.6 Based on publically available BGS boreholes and BGS mapping, the Made Ground can be categorised into various types, with the main descriptions including:

a. embankment construction material associated with the existing M42 motorway;

b. worked ground (i.e. areas where ground has been cut away such as quarries);

c. infilled ground (i.e. areas where ground has been cut away then wholly or partially backfilled); and

d. areas of undifferentiated Made Ground (i.e. areas which have been built up above natural ground level by man-made deposits, but excluding embankment construction materials which are considered separately).

10.6.7 The thickness of the embankment construction material varies from between 1.2m and 6m based on historical ground investigation data. The material is a mixture of granular and cohesive deposits with concrete, brick and rubble being the typical constituents. Based on a review of the borehole logs from the intrusive ground investigation for the Scheme, a number of boreholes encountered material considered to be former road surface layers and road sub-base.

10.6.8 No information is available in relation to the depth, thickness or composition of the worked or infilled ground from the historical studies. This is likely to be variable and specific to individual features. Worked ground is associated with former clay and sand extraction pits that are located in the grassland surrounding Bickenhill and it is also indicated to be associated with road and railway cuttings. A large number of localised infilled ground relate to infilling of former ponds.

10.6.9 Areas of undifferentiated Made Ground have been encountered during historical ground investigations in the area. Undifferentiated Made Ground represents areas which have been built up above natural ground level (but excluding embankment construction materials which are considered separately). This includes spoil heaps and areas of major construction (such as the NEC), and it comprises both granular and cohesive materials. Up to 7.1m of undifferentiated Made Ground has been encountered during historical ground investigations, with the thickest material encountered located around the area of the Clock Interchange.

10.6.10 Areas of Made Ground are located immediately to the northwest and northeast of Junction 6, occupying the area between the M42 and the eastbound A45. According to historical studies, infilled ground is encountered associated with landfills, former mineral workings and localised former ponds. Worked ground is found where the ground has been cut away but not infilled, including the M42 earthworks cuttings.

Superficial deposits

10.6.11 Superficial deposits are shown on the BGS geological maps [REF 10-43] to be absent across the majority of the Scheme. Localised outcrops of alluvium deposits (clay, silt, sand and gravel) associated with the Shadow Brook and Low Brook intersect the Scheme on the M42 and A45. Glaciofluvial deposits are present outcropping in patches across the central part of the Scheme north of Shadowbrook Lane with wider expanses south of Hampton Lane Farm and to the north of the M42 Junction 6. The southern part of the study area, the area between Friday Lane and Henwood Lane, variably comprises alluvium, river terrace deposits and glaciofluvial deposits.

10.6.12 Where encountered during historical ground investigations, the alluvium referred to comprises of a mixture of clays, silts, sands and gravels with rare layers of peat and varying in thickness from 1.80m to 3.55m. Glaciofluvial material, where encountered, was found to comprise typically sand and gravels (occasionally clay or silt with granular secondary constituents) and varying in thickness from 2.10m to 10.80m.

Bedrock geology

10.6.13 The Scheme is entirely underlain by the Mercia Mudstone Group comprising Sidmouth Mudstone Formation, Branscombe Mudstone Formation and Arden Sandstone Formation. These are sedimentary bedrock formed in the Triassic Period. Most parts of the Arden Sandstone Formation are recorded as sandstone, siltstone and mudstone. However, in some cases, notably an outcrop near to the southern part of the Scheme in between the village of Catherine-de-Barnes and the M42, the strata is recorded as mudstone only.

10.6.14 The Mercia Mudstone Group was found to be present along the entire site investigated during historical studies. However, no boreholes encountered material considered to be non-weathered Mercia Mudstone (Zone 1), with up to approximately 10m to 15m of fully/partially weathered material being encountered. The Arden Sandstone Formation was proven up to 20m in thickness.

Ground conditions encountered during the Scheme's 2018 ground investigation

10.6.15 The 107 exploratory holes advanced as part of the Scheme's 2018 Ground Investigation encountered a variable thickness of topsoil and/or Made Ground overlying natural superficial deposits of Alluvium and Glaciofluvial Deposits, overlying the Mercia Mudstone Group. The succession encountered in the exploratory holes confirmed the anticipated geology. However, the Glaciofluvial Deposits encountered across the Scheme were more widespread than expected. No river terrace deposits were encountered.

10.6.16 A summary of the ground conditions encountered is presented as **Table 10.4**.

Table 10.4: Summary of ground conditions encountered in 2018 Ground Investigation

Strata	Name	Number of boreholes strata encountered in	Depth range to top (m bgl[1])	Proven thickness (m)
Topsoil	-	72	0.00	0.10 – 0.70
Made Ground	-	37	0.00 – 0.30	0.25 – 8.50[2]
Natural superficial deposits	Alluvium	10	0.20 – 7.50	0.10 – 2.45
	Glaciofluvial deposits	60	0.10 – 3.60	0.20 – 4.30[2]
Solid Geology	Mercia Mudstone Group (Undifferentiated)	103	0.25 – 9.80	0.10 – 26.00[2]
	Arden Sandstone	21	3.50 – 24.20	0.05 – 14.00[2]

[1] bgl – below ground level
[2] Full thickness not proven

Land stability

10.6.17 Information contained within the Envirocheck Report [REF 10-40] indicates that the following ground stability hazards may exist within the geology study area. These are presented in **Table 10.5.**

Table 10.5: BGS ground stability hazard ratings

Hazard	Hazard Potential
Shrinking or Swelling Clay	No hazard to low
Landslide	Very low to moderate
Ground Dissolution	No hazard potential
Compressible Ground	No hazard to moderate
Collapsible Ground	No hazard to very low
Running Sand	No hazard to low

Sensitive sites

10.6.18 Bickenhill Meadows, which comprises two distinct units of grassland, is designated as a SSSI for ecological features (see Chapter 9 Biodiversity) is considered for the purpose of this assessment an ‘ecological receptor’. The River Blythe, and Coleshill and Bannerly Pools, are also designated as SSSIs.

10.6.19 The extended study area is located within a surface water Nitrate Vulnerable Zone and much of the geology study area is within a Protected Drinking Water Safeguard Zone for surface water.

10.6.20 There are no geological SSSIs within the Scheme or within the geology study area.

10.6.21 Information obtained from the WGCG [REF 10-38] indicated there is one Local Geological Sites (LGS) (formerly Regionally Important Geological and Geomorphological Sites) within the geology study area. This relates to Nursery Cottage, Arden Brickworks (also known as 'Jacksons (Warwickshire)'). The Nursery Cottage LGS relates to a large active brickworks and clay pit, 28m deep, located south of the A45 between the M42 Junction 6 and Stonebridge Island to the east, approximately 230m from the Scheme. This LGS provides a good example of fresh exposures of the Triassic, Mercia Mudstone Group. This site information was last reviewed by WGCG in 2009.

Mining and mineral resources

Mining

10.6.22 The Scheme is not in an area that might be affected by coal mining. According to the PSSR [REF 10-41], a review of the Mining and Instability West Midlands Report indicates no significant mining has taken place in the area considered by the PSSR and that the underlying strata are not coal bearing.

Mineral resources

10.6.23 There are two BGS Recorded Mineral Sites within the geology study area detailed as follows:

a. Arden Landfill: also known as Jackson's Landfill and the location of Arden Brickworks detailed above. This is located approximately 230m from the Scheme south of the A45 between the M42 Junction 6 and Stonebridge Island to the east. It was a dormant opencast site for which the commodity is recorded as common clay and shale. Based on information provided by SMBC there has recently been a recommencement of activity at the site both with infilling of the old void area, plus new clay extraction activity in the last two to three years. The old mineral consents were consolidated in the review of old mineral planning consents and a further review of the consolidated set of minerals conditions has since been postponed for a further 15 years. Additionally, other past uses included the base for a demolition company, open storage for civils contractors, plus as Materials Recovery Facility (MRF) and related activities. The MRF operation is currently the subject of a ten year temporary consent which expires in approximately September 2019. The mineral extraction is authorised to 2042. Additionally SMBC commented that a Regionally Important Geological Site designation applies to part of the site, although this designation will be lost as the long term restoration plan is for infilling and restoration of the whole minerals site to agriculture and

b. Middle Bickenhill Brick Works: located approximately 70m from the Scheme, and also south of the A45 between the M42 Junction 6 and Stonebridge Island to the east. This is a ceased opencast site for which the commodity is recorded as common clay and shale.

10.6.24 According to the PSSR [REF 10-41], the BGS memoir for BGS Sheet 168 states that Jackson's Brick Pit (approximately 600m east of Junction 6 (approximate national grid reference 420638, 282588) is the site of a former clay extraction pit within the Mercia Mudstone Group. The memoir also indicates the possibility for localised bell pits, associated with historical extraction of the Mercia Mudstone Group for agricultural use, to be present within the area considered by historical studies. It is noted that no information regarding the location of such pits is available. Although no definitive evidence is available, it is highlighted that it is possible that small ponds within areas of glaciofluvial deposits and Mercia Mudstone represent former sand and gravel, and clay extraction pits, respectively.

10.6.25 The SMBC Plan Review Proposals Map (November 2016) [REF 10-44] and Warwickshire County Council (WCC) Warwickshire Minerals Plan Publication Consultation (December 2016) [REF 10-45] identify a Mineral Safeguarding Area for sand and gravel aggregate within the geology study area. The footprint of this mineral safeguarding area covers the area east of the M42 and west of the A452.

10.6.26 The area of Mineral Safeguarding Area land to the east of the NEC and M42 is identified as a Mineral Safeguarding Area in the Solihull Local Plan [REF 10-44] and remains the current policy designation. This is maintained in the emerging Local Plan Review. The site is the subject of two major planning permissions for sand and gravel extraction, one of which was implemented some time ago but recently became the subject of a Stop Notice by HS2 Limited, which caused the mineral extraction to cease on 1st December 2017 [REF 10-46]

10.6.27 BGS Geo-index website [REF 10-43] shows that the majority of the Scheme (i.e. the south of Park Farm on the A452) lies within a sand and gravel Mineral Assessment Area, with SMBC listed as the Mineral Planning Authority for the majority of the Scheme and surrounds (WCC in the far north-east). One Mineral Planning Permission (point) is recorded as an active site for common clay and shale south of the A45 between the M42 Junction 6 and Stonebridge Island to the east, and this relates to the aforementioned landfill/brickworks site.

Soil chemistry

10.6.28 The PSSR [REF 10-41] reports information in the Envirocheck Report [REF 10-40], and information provided by the BGS [REF 10-31], on the natural background concentrations, in the locality, for certain heavy metals as follows:

a. arsenic (<15 mg/kg);

b. cadmium (<1.8 mg/kg);

c. chromium (20-90 mg/kg);

d. lead (<150 mg/kg); and

e. nickel (15-30 mg/kg).

10.6.29 No further information on this is presented as part of the Envirocheck Report [REF 10-40].

Agricultural land and other land designations

10.6.30 As detailed in the Natural England Technical Information Note TIN 049 [REF 10-47], the ALC system classifies land into five soil grades, with Grade 3 soils being subdivided into Subgrades 3a (good) and 3b (moderate). The BMV land is defined as ALC Grades 1, 2 and 3a. This is the land that is most flexible, productive and efficient in response to inputs and which can best deliver future crops. Grade 4 soils are defined as poor, and Grade 5 soils described as very poor. The ALC system is used by Natural England and others to provide advice to planning authorities if development is proposed on agricultural land that could potentially grow crops.

10.6.31 The West Midlands Region 1:250,000 scale ALC map [REF 10-48] indicates that the study area falls under agricultural land classification Grade 3. The DEFRA magic website [REF 10-49] further classifies some of the farmland in the west of the M42. This includes the Walford Hall Farm area adjacent to the M42 near Friday Lane which is classed mainly as Grade 3a and Grade 3b with a small area of Grade 2. Land adjacent to the west of the B4438 Catherine-de-Barnes Lane, occupied by Bunts Wood, Woodhouse Farm, Hampton Coppice and Castle Hills is mainly Grade 3b but also has areas of Grade 2 and 3a land with a small area of Grade 4 land in the corner adjacent to Damson Parkway.

10.6.32 An Agricultural Land Classification and Soil Resources Survey was undertaken by Soil Environment Services Ltd in November 2018, the findings of which are reported in Appendix 10.2 [**TR010027/APP/6.3**]. The purpose of the survey was to investigate the agricultural land classification and soil resources of land which is proposed to be developed as part of the Scheme, by means of a detailed survey of soil and site characteristics.

10.6.33 The results of this survey concluded the absence of any Grade 1, 2, 4 and 5 agricultural land areas as initially derived from ALC mapping. The areas of each ALC grade are summarised in **Table 10.6**.

Table 10.6: Agricultural land classification grades and associated areas

Grade/Subgrade	Description	Area (ha)
3a	Good quality agricultural land	21.4
3b	Moderate quality agricultural land	82
Unsurveyed land	N/A	21.7

10.6.34 The BMV agricultural land present within the footprint of the Scheme includes Grades 3a land. The land not considered BMV agricultural land at the site includes Grade 3b land.

Hydrogeology

10.6.35 The superficial deposits (alluvium, river terrace and glaciofluvial) underlying the Scheme are classified by the EA as Secondary A aquifers.

10.6.36 The underlying bedrock including the Sidmouth Mudstone and Branscombe Mudstone Formations are classified as Secondary B aquifers. The Arden Sandstone Formation bedrock is classed as a Secondary A aquifer, with the exception of areas where it is recorded as mudstone only (such as the outcrop near to the southern part of the Scheme in between Catherine-de-Barnes and the M42), where it is classed as Secondary B. A more detailed review of the water environment is provided in Chapter 14 Road drainage and the water environment.

10.6.37 There are no groundwater source protection zones within 500m of the Scheme. The groundwater vulnerability zones around the area of the Scheme are mainly minor aquifers, with high vulnerability and minor aquifer with low vulnerability.

Historical ground investigations

10.6.38 The borehole records from the historical ground investigations associated with the development of the M42 provide groundwater level data in the areas adjacent to the M42 Junction 6. In summary, areas of shallow groundwater generally coincide with areas of granular made ground, granular alluvium and glaciofluvial deposits. In some cases multiple strikes are recorded within an exploratory hole, where water bearing granular stratum is confined by cohesive material of very low permeability.

10.6.39 According to the review of the historical ground investigation data, groundwater was generally encountered within 10m of the ground surface, with the bulk of groundwater strikes encountered between 1m and 8m of the ground surface. There are no obvious trends identified in groundwater levels with regards to locations within the study area considered as part of historical studies. However, it should be noted that the historical ground investigation data considered dates back to the 1970s and 1980s and so groundwater conditions may have since changed.

10.6.40 The Envirocheck Report [REF 10-40] indicates that there is one groundwater abstraction license located within the Scheme, and a further ten groundwater abstraction licenses located outside, but within the extended study area (i.e. within the area 500m beyond the Scheme). A summary of the groundwater abstraction license details is provided in **Table 10.7**.

Table 10.7: Groundwater abstractions within the extended study area

License holder	License number	Type of use	Location (approximate)
Birmingham Corporation (Warren Farm)	03/28/11/0079	General Farming And Domestic	Present within the Scheme approximately 200m north of the M42 Junction 6 southbound off-slip road
[redacted]	03/28/11/0020	General Farming And Domestic	115m east of the Scheme and approximately 350m west of Chester Road
Melbick Nurseries Limited	03/28/11/0081	Horticulture And Nurseries: General Use (Medium Loss) – deep well	196m east of the Scheme, off Chester Road (A452)
Melbick Nurseries Limited	03/28/11/0081	Horticulture And Nurseries: General Use (Medium Loss) – shallow well	196m east of the Scheme, off Chester Road A452 (southbound)
Melbick Nurseries Limited -	03/28/11/0081	Horticulture And Nurseries: General Use (Medium Loss) – shallow well	204m east of the Scheme, off Chester Road A452 (northbound)
[redacted]	03/28/11/0020	General Farming And Domestic	204m east of the Scheme, off Chester Road A452 (northbound)
[redacted]	03/28/11/0065	General Farming And Domestic	286m east of the Scheme, off the A446 westbound approach to the A446/A452 interchange
Wyevale Garden Centres G&L Limited	Md/028/0011/006	Horticulture And Nurseries: Spray Irrigation - Direct	310m east of the Scheme off the Chester Road A452 (southbound)
The Garden & Leisure Group Limited	Md/028/0011/006	Horticulture And Nurseries: Spray Irrigation - Direct	310m east of the Scheme off Chester Road A452 (southbound)
Whale Tankers Ltd	03/28/11/0131	Other Industrial/Commercial/Public Services: Process Water	442m west of the southern extent of the Scheme where the M42 crosses Henwood Lane
[redacted]	03/28/12/0014	General Farming And Domestic	461m north-west of the northern extent of the Scheme. Approximately 200m west of the M42 Junction 7 off-slip road.

10.6.41 One discharge consent is recorded [REF 10-40] within the Scheme, with details as follows:

a. Sewage Treatment Works - Final Effluent - Discharge to River Blythe - Issued: 12 May 1969.

10.6.42 However, it should be noted that this discharge consent is associated with the historical 'Warren Farm', removed in the 1980s in association with the construction of the M42. As such, this discharge consent is considered to be defunct.

Groundwater encountered during the 2018 Ground Investigation

10.6.43 Groundwater was encountered in approximately 60% of the exploratory holes advanced during the 2018 ground investigation. A further 17% of the boreholes that were dry during exploration were subsequently installed and have been observed to contain water as part of subsequent initial monitoring undertaken between March and August 2018.

10.6.44 Groundwater was only encountered within the Glacio-fluvial deposits and Mercia Mudstone Group. Groundwater was encountered within both the cohesive and granular Glaciofluvial Deposits at depths ranging from 0.3m to 2.5m. The strikes, where described, were noted most frequently as 'seepage' and occasionally 'slow' or 'medium inflow', reflecting the presence of perched water in the Glacial Deposits. Groundwater strikes in the Mercia Mudstone Group ranged from 0.3m to 22.5m below ground level and were noted in a variety of material types. Where the strikes were described they were generally recorded as 'seepage' or 'slow inflow' and to a lesser degree 'medium inflow', with only two strikes recorded as 'fast inflow'.

10.6.45 Groundwater monitoring to date has been undertaken over two phases between March to May 2018 and July to August 2018 with groundwater level readings indicating a limited variation in water levels. An ongoing monthly groundwater monitoring regime is currently being undertaken at the two Bickenhill Meadows SSSI units as part of the wider assessments associated with Chapter 14 Road drainage the water environment and Chapter 9 Biodiversity. The data from this monitoring will be used to inform detailed design.

Hydrology

10.6.46 Three main surface water bodies cross the Scheme:

a. Hollywell Brook;

b. the River Blythe; and

c. Shadow Brook.

10.6.47 Several minor drains and small unlabelled ponds are located within the Scheme (see Chapter 14 Road drainage and the water environment). In addition, the Grand Union Canal, Low Brook, Pendigo Lake and Coleshill Pool are within 250m of the Scheme in the south/south west, central area, north and far north, respectively.

10.6.48 Based on the Envirocheck Report [REF 10-40] no surface water abstractions are located within the Scheme. One surface water abstraction is within the extended study area and is located approximately 400m to the east of the Scheme, adjacent to Holywell Brook. It relates to a license held by Packington Estate Enterprises Limited and listed as 'Mineral Products: Make-Up Or Top Up Water'.

10.6.49 The River Blythe, and Coleshill and Bannerly Pools (the most westerly of which, Coleshill Pool, is located to the east of the existing M42 in the far north of the geology study area), are surface water receptors which are designated as SSSIs. The extended study area is also located within surface water Nitrate Vulnerable Zone, whilst much of the Scheme is within a Protected Drinking Water Surface Water Safeguard Zone. The water environment is considered further in Chapter 14 Road drainage and the water environment.

10.6.50 According to the Envirocheck Report [REF 10-40], three pollution incidents to controlled waters are recorded within the Scheme. All were Category 3, minor incidents.

a. Grand Union Canal; Large Amount Of Rubbish Fridges etc - 6 April 1999, Receptor: Grand Union Canal;

b. Amenity Affected; Septic Tank Overflowing To Brook – 19 July 1996, Receptor: River Blythe Catchment; and

c. Ten Litres Foam To Water; Foam type unknown; Cause of incident: Fire - 2 December 1997, Receptor: Watercourse - River Blythe Catchment.

10.6.51 There are 12 further pollution incidents recorded within the extended study area (dates between 1996 and 1999). Eleven of the pollution incidents were classed as Category 3 (minor incident) severity and only one classed as Category 2 (significant incident). The significant incident occurred on 16 January 1997, caused by road traffic accident resulting in 1,000 litres of aviation kerosene spilling into the Grand Union Canal.

10.6.52 There are 37 discharge consents recorded within the geology study area [REF 10-40], only one of which is recorded to be within the Scheme relating to the aforementioned defunct discharge consent located at the historical ‘Warren Farm’. Thirteen of the discharge consents are granted to Severn Trent for sewage discharges, with the remaining granted mainly to domestic properties (including farm houses) and trade companies. The receiving waters for these discharge consents include tributaries of River Blythe, Eastcote, Low, Bannerly, Shadow, Ravenshaw and Hollywell Brooks.

10.6.53 The Substantiated Pollution Incident Register records within the Scheme, a Water Impact Category 1 Major Incident caused by "Oils or Other Organic Products" according to the Envirocheck Report [REF 10-40]. The incident occurred on 14 December 2003 and was also a Land Impact Category 3 - Minor Incident. The incident was recorded as being located on the M42 carriageway, north of Friday Lane and south of the B4102 Solihull Road (Solihull Road). No further Substantiated Pollution Incident Register records are located within the extended study area.

10.6.54 There are no Local Authority Pollution Prevention Control records present within the Scheme, the nearest being situated approximately 20m from the Scheme, relating to the crushing of material (aggregate processing). Eight Local Authority Pollution Prevention Control records are situated within the extended study area. One Integrated Pollution Prevention and Control record is present within the extended study area, situated approximately 140m from the Scheme and relates to the disposal or recovery of hazardous waste with a capacity exceeding 10 tonnes per day involving biological treatment.

Potential sources of contamination

10.6.55 A sources/constraints plan portraying the land contamination sources and discharge water consents is presented as **Figure 10.1** [**TR010027/APP/6.2**].

10.6.56 Data obtained from the available sources have been reviewed to identify current and historical potential contaminative land uses. A summary of the key areas of potentially contaminated land within the geology study area is presented in **Tables 10.8** and **10.9**, split by those within the Scheme and those beyond the Scheme outward to 250m). These tables exclude regulated landfills and other waste disposal features (evidence of non-regulated wastes disposal included), as well as other regulated activities, which are presented separately. The tables also exclude railways and roads. These potential sources intercept the Scheme but as a result of their linear construction they span both the Scheme and the overall study area. Details of the key roads and railway land associated with the Scheme are therefore presented separately in **Table 10.10**.

10.6.57 Made Ground (anthropogenic material) associated with construction and development is also a potential source of contamination but as it is widespread is not included within **Table 10.8** below.

Table 10.8: Summary of potential sources of contamination within the Scheme

Land use type	Number	Potential sources within the Scheme[1,2]	
		Date	Land use
Airports	1	Current Land Use	Birmingham Airport (C56)
Car Parks	7	Current Land Use	NEC/Airport Overspill car park (C18) NEC Eastern (C19) NEC SE 1 (C20) NEC Southern Carpark (C21) NEC NE 2 (C27) NEC North (C28) NEC SE 2 (C29)
Depots	1	Current Land Use	DHL Stonebridge Trailer Park (Logistics Depot) (C02)
Electricity Substation	1	Current Land Use	Substation associated with The National Motorcycle Museum (C54)

Land use type	Number	Potential sources within the Scheme[1,2]	
		Date	Land use
Farms	3	1886 to 2006, 1886 to 1955 1888 to 1999	Cottage Farm (H18) Warren Farm (H19) Myrtle Cottage Farm (H24)
	3	Current Land Use	Hampton Lane Farm (C35) Church Farm (C40) Long Acre Farm (C57)
Industrial	1	1979 to 1991	A. Arnall Garage Services (H23)
Sewage Works	1	Current Land Use	Sewage Pumping Station (Clock Lane) (C44)
Fly Tipping	Two areas of fly-tipped material (C14, C15) were observed during a site walkover (undertaken on the 14 and 15 September 2017) in the wooded area adjacent to the M42 off Solihull Road comprising used tyres and brick rubble.		

[1] Excluding roads/railways and landfills/waste, presented in **Table 10.10** and **Table 10.11** respectively.
[2] Where reference is made to dates, the feature has been identified from the Envirocheck Report [REF 10-40] historical land use maps, unless otherwise stated. Where no reference is made to dates, the feature has been identified from the Envirocheck Report [REF 10-40] datasheets and available current mapping, unless otherwise stated.

10.6.58 With regards to the pits and ponds it should be noted that there are various historical pits and ponds; (some of which have been infilled) which are present within the study area. However, there is not considered to be any potentially significant historical pits or ponds that may give rise to potential source of contamination within the Scheme.

Table 10.9: Summary of potential sources of contamination within 250m of the Scheme[1]

Land use type	Number	Date	Potential sources within 250m of the Scheme[2,3]
			Land use
Brick Works	1	1904 to 1999	Old Arden Brickworks (H20)
Car Parks	7	Current Land Use	Airport/Train station car park (C16) Airport/Train station expanded car park (C17) NEC Centre South (C23) NEC SW (C24) NEC West - Genting Arena (C25) NEC NE 1 (C26) NEC E5 Car park (C45)
Depots	4	1980 to 1992 1980 to 1994 1993 to 1999 1993 to 1999	Unnamed 'Depot' (H15) Unnamed 'Depot' (H26) Unnamed 'Depot' (H28) Croggers Road Service Depot (H34)

Land use type	Number	Date	Potential sources within 250m of the Scheme[2,3]
			Land use
Electricity Substation	4	Current Land Use	Unnamed Substations (C48, C49, C50, C53)
Farms	4	1955 to 1999 1888 to 1965 1888 to 1967 1962 to 1999	Oak Farm (H11) Hurdle Hall (H13) Common Farm Cottage (H29) Brackenlands Farm (H30)
	9	Current Land Use	Heath Farm (C01) Home Farm (C05) Nursery Cottages (C06) Common Farm (C07) Walford Hall Farm (C36) Grange Farm (C37) Glebe Farm (C39) Hazel Farm (C42) Yew Tree Farm (C43)
Fuel Filling Stations	1	1937 – 1999	Fina Petrol Station (H35)
	1	Current Land Use	Bickenhill Service Station (C30)
Industrial	12	Historical - Unknown	Sand, Gravel & Other Aggregates - Lafarge Aggregates (H01) Salvage Dealers - Motor Salvage (UK) Ltd (H02) Crane Hire, Sales & Service - Dewsbury & Proud (H03) Cement Manufacturers & Distributors – Tarmac (H04) Medical Equipment Manufacturers - Ferraris Group Plc (H05) Telecommunications Equipment & Systems - Detewe Ltd (H06) Freight Forwarders- Now Cargo Ltd (H07) Freight Forwarders- First Port Shipping (H08) Pottery Manufacturers & Suppliers – Denby (H09) Concrete & Mortar Ready Mixed - Lafarge Aggregates Ltd (H10) Incol Pressworks Ltd (H33) Anne's Pantry (H36)
	12	Current Land Use	Office Furniture & Equipment; Central Design Services (C03) Commercial Cleaning Services - J M Ellis Holdings Ltd (C04) Bath Resurfacing - Alscot Bathroom Company (C08) Floor Cleaning & Polishing Equipment - Manufacturers & Distributors – Koalaflor (C09) Cement Manufacturers & Distributors – Tarmac (C11) Crane Hire, Sales & Service - N M T Crane Hire (C12) Catering Equipment – Procook (C13) [redacted] Furniture Manufacturers - Home & Office - Oaktree Frames (C32) Car Accessories Manufacturers - Trekkers Ltd (C33)

Land use type	Number	Date	Potential sources within 250m of the Scheme[2,3]
			Land use
			Lingerie & Hosiery Manufacturers & Wholesalers - Scala Agenturen Ltd (C34) Warehouse (Fujitsu) - Part of Birmingham Business Park (C52)
Nurseries (Horticulture)	1	1954 - 1996	Glasshouses, Church Lane (H22)
	2	Current Land Use	Braceys Nurseries and Garden Centre (C38) Melbicks Garden Centre (C58)
Ponds	2	Current Land Use	Pendigo Lake (man-made) (C46) Coleshill Pool (C51)
Quarries	1	Current Land Use	Current Mineral Extraction to north-east of scheme (C47)
Railway Stations	1	Current Land Use	Birmingham International Railway Station (C10)
Refuse Tips	1	Historical – Unknown	Un-named refuse tip in former Old Arden Brickworks (H25)
Sewage Works	1	1953 – 1980	Sewage Works for Meriden R.D.C. (H17)
	1	Current Land Use	STW Barton (C41)
Tanks	2	1980 – 1992 1904 – 1999	Tanks associated with Depot at same location (H16) Tanks associated with Old Arden Brickworks (H21)
Works	4	1904 – 1999 1954 – 1999 1961 – 1999 1937 – 1999	Unnamed Works Building (H12) Scaffolding Factory (H14) Unnamed Works Building (H27) Unnamed Works Building (H37)

[1] Excluding roads/railways and landfills/waste, presented in **Table 10.10** and **Table 10.11** respectively.
[2] Where reference is made to dates, the feature has been identified from the Envirocheck Report [REF 10-40] historical land use maps, unless otherwise stated. Where no reference is made to dates, the feature has been identified from information within the Envirocheck Report [REF 10-40] datasheets and available current mapping, unless otherwise stated.
[3] Comprising the area between the Scheme and within 250m of the Scheme.

Table 10.10: Summary of potential sources of contamination (roads and railways) within the geology study area

Land use	Description
Roads	The M42 (oriented approximately north to south). Road network associated with the NEC and surrounds east of Bickenhill noted from mid-late 1970s. The A45 trends approximately west to east.
Railways	The London and North Western Railway 1886 to present oriented north-west to south-east, east of Bickenhill (crosses the Scheme in between the Clock Lane Interchange and the M42 Junction 6). Currently known as Birmingham Loop (C55). The Midland Railway at the eastern extent of the Scheme close to the M42 Junction 6 from 1886 (H31). Dismantled by 1970. A mineral railway associated with the Old Arden Brickworks is present between 1954 and 1961 (H32).

Landfill and other waste features

10.6.59 A summary of the landfills and other waste features identified from the Envirocheck Report [REF 10-40] to be within, and within 250m of the Scheme is presented in **Table 10.11**. Waste types accepted were noted to be wide-ranging. These are considered to represent additional key potential areas of contamination.

Table 10.11: Summary of landfills and other waste features within the geology study area

Land use type	Waste features within the Scheme		Waste features within 250m of the Scheme [1]	
	Number	Land use	Number	Land use
BGS Recorded Landfills	1	Church Farm (L28)	2	Walford Hall Farm (L27) Jacksons Brickworks (L29)
Historic Landfills	4	Glebe Farm (L10) Castle Hills Farm (L11) Bickenhill Lane (L12) Site Corner Clock Lane (L15)	13	Jacksons Brickworks (L13, L16) Shadowbrook Lane (L14) Windbridge Nurseries (L17) Friday Lane (L30, L32, L33) Walford Hall Farm (L31) Opposite Church Farm (L34) Hargrave Farm (L35, L36) Rear of Jacksons Brickworks (L37) Brackenlands Farm (L38)
Licensed Waste Management Facilities	-	-	5	Sita - Jackson Brickworks (L42) Enterprise Managed Services Ltd - Household Waste Amenity Sites (L43) Eastcote Nurseries - Friday Lane Landfill Site (L41, L44, L45)
Local Authority Recorded Landfill	2	Mercon Construction (L18) Castlehill Farm (L19)	5	Friday Lane (L20, L21, L39) Shadow Brook Lane (L22) Jacksons Brickworks (L23)
Infilled Pond	-	-	2	Spinney Pool (L51) Coleshill Pool (L52)
Registered Landfill Sites	2	'Mercon Construction Ltd - Landfill' (L24) 'Sheridan Contractors – Landfill ' (L25)	6	B J O'Reilly & Sons Ltd (L26) Bulldog Demolition Ltd (L40) Eastcote Nurseries (Solihull) Ltd (L46) BM Fisher (L47) Licence Holder: West Midlands Excavation (L48) Rawlins Brothers (L49)
Other Pits/Quarries/Tips/ Waste	16	Tip - mainly builders waste (L03, L03)[2] Contractors unsuitable tip (L04, L04)[2] Agricultural waste dump (L05, L05)[2]	4	Opencast - Arden Landfill (L01) Opencast - Middle Bickenhill Brick Works (L02) Refuse Tip, Church Farm (L50) Quarry mentioned in PSSR review at these coordinates. Due

Land use type	Waste features within the Scheme		Waste features within 250m of the Scheme [1]	
	Number	Land use	Number	Land use
		Previous agricultural waste dump (L06, L06)[2] Pit infilled with waste (L07,L06)[2] Contractors unsuitable tip (L08,L08) [2] Infilled Ground - Pit partially backfilled with domestic refuse (L09,L09) [2] Old Marl Pit (L54) Backfilled Borrow Pit (L56)		to detailed mapping not going back far enough AECOM is not able to corroborate this information in the historical review (L53)

[1] Comprising the area between the Scheme and within 250m of the Scheme.
[2] It should be noted that in some cases the co-ordinates presented in the PSSR [REF 10-41] for the features L03 to L09 (inclusive) did not always align with the associated polygons. The polygons were considered more likely to represent the accurate feature footprint; however, for completeness, and to provide a clear reference back to the PSSR source data, the features for L03 to L09 (inclusive) have been included in this table and plotted on the figure based on both the polygons and co-ordinates provided in the PSSR.

Potential sources of contamination bisected by the mainline link road

10.6.60 Potential sources of contamination bisected by the mainline link road and hence considered to present high risk based on excavation potential during construction, are summarised in **Table 10.12**.

Table 10.12: Summary of potential sources of contamination bisected by the mainline link road

Site reference	Historical land use	Current land use	Additional information
L10, L18, L28, L24	1988 to 1989 Church Farm/ Glebe Farm Landfill	Vacant/Overgrown	Operated by Mercon Construction Small (Equal to or greater than 10,000 and less than 25,000 tonnes per year) Authorised waste: clean hardcore, natural occurring sands, gravels, clays, subsoil, topsoil SMBC[1] documents SL588 and 028, dated 6th July 1988 and 5th August 1991 respectively, detail licences to deposit waste. A handwritten note states 'possibly contaminated – ashes?'. Pertinent points of licence: No materials other than topsoil, subsoil, and builders rubble to be deposited 30 loads per day The operator should protect the water course running along western boundary The depth of any layer shall not exceed 1.5m after compaction

Site reference	Historical land use	Current land use	Additional information
L11, L19	1977 to 1979 Castle Hills Farm Landfill	Open Field, with small portion bisecting adjacent Gaelic Sports Facility	Operated by Bulldog Demolition Deposited waste included Inert Waste SMBC[1] documents SL42 and 023, dated 17/02/77 and 02/08/91 respectively, detail licences to deposit waste. A handwritten note states 'possibly contaminated – ashes?'. Pertinent points of licence: Only builders rubble and excavated soil 150 loads per day Depth must not exceed 9 feet No materials tipped within 5m of the perimeter of the site
H18	1887 – 2001 Cottage Farm	Field adjacent to existing A45	No further information – historical farm identified from mapping, potential for Made Ground
H19	1888 – 1965 Warren Farm	Field adjacent to existing M42	No further information – historical farm identified from mapping prior to construction of M42, potential for Made Ground
H32	1886 – 1980	Dismantled Railway	Midland Railway – Whitacre and Hampton Branch
C14, C15	Undeveloped Land	Fly-tipped areas	Fly-tipped areas of tyres and demolition rubble identified during site survey
C18, C19, C20, C29	Agricultural Land	Car Parks associated with the N.E.C.	No further information - Potential for considerable Made Ground
L55	Made Ground	Varied	Made Ground (from PSSR Geohazard Plans)
L04, L08	Refuse Tips	Field adjacent to existing M42	'Contractors Unsuitable Tip' (from PSSR [REF 10-41] source data)
L56	Backfilled Borrow Pit	Field adjacent to existing M42	Pit identified from aerial photography reviewed as part of HS2 source data
-[2]	Varied	Roads	M42, A45 and existing road network associated with the NEC and surrounds east of Bickenhill noted from mid-late 1970s.

[1] Documents obtained from SMBC.
[2] No Reference.

Identified receptors

10.6.61 A series of receptors plans are appended to this report, presented as **Figures 10.2** to **10.5** [**TR010027/APP/6.2**]**. Figure 10.2** [**TR010027/APP/6.2**] portrays the surface water courses, groundwater abstractions and sensitive land uses situated in the area in and around the Scheme. Figure 10.3 displays the aquifer designations, source protection zones, and drinking water safeguard zones within the area in and around the Scheme. **Figure 10.4** [**TR010027/APP/6.2**] presents the ALCs and **Figure 10.5** [**TR010027/APP/6.2**] presents the known utilities within the area in and around Scheme.

Receptors susceptible to land contamination and ground hazard impacts

10.6.62 The principal receptors which could be affected from contamination which is created or affected by construction and/or operation of the Scheme include:

a. human health: construction and maintenance workers, off-site receptors and future road/site users;

b. controlled waters: groundwater, surface water features and water abstractions;

c. construction materials: existing and new concrete and structures associated with the highway;

d. sensitive sites (including ecological receptors and soil/geological resource receptors);

e. surrounding land uses: agricultural land; and

f. property.

10.6.63 High sensitivity human receptors comprise nearby residents, workers in, and visitors to, commercial properties, and members of the public accessing areas of open space and any adjacent community facilities. Construction workers also represent additional high sensitivity human receptors during the construction phase only. Road users by their very nature are transient and are therefore considered to represent a lower risk, although laybys may provide areas for longer stay visits to the site.

10.6.64 Groundwater receptors include the Secondary A aquifers associated with both the superficial deposits and the Secondary A and Secondary B aquifers associated with the bedrock geology. As the nearest recorded groundwater abstraction to the Scheme was situated at Warren Farm, a historical farm removed during the construction of the M42 in the 1980s, this is considered to be defunct. The nearest active groundwater abstraction is located approximately 115m east of the Scheme at Common Farm, used for general farming and domestic purposes, and is therefore considered as a groundwater (resource) receptor.

10.6.65 The primary surface water receptors include the Hollywell Brook, River Blythe and Shadow Brook. Other surface water receptors include minor drains and small unlabelled ponds, the Grand Union Canal, Low Brook, Pendigo Lake and Coleshill Pool located within the extended study area. It should be noted that both the Holywell Brook and the Shadow Brook are tributaries of the River Blythe, which itself is a tributary of the River Tame. The Envirocheck records the River Blythe to be of 'River Quality B'.

10.6.66 Sensitive receptors include the River Blythe, Bickenhill Meadow, Coleshill and Bannerly Pools, all designated as SSSIs considered to be of moderate sensitivity, as well as ancient woodland. The extended study area is also located within a surface water Nitrate Vulnerable Zone, whilst much of the Scheme is within a Protected Drinking Water Surface Water Safeguard Zone.

10.6.67 Property receptors comprise residential and commercial properties, agricultural crops, livestock and infrastructure such as below ground utilities.

Soil and geological resource receptors

10.6.68 The principal receptors which have the potential to be impacted upon by the Scheme during construction and/or operation include:

a. Mineral Safeguarding Areas located within the Scheme and the geology study area for sand and gravel aggregate. Located in the area which forms the triangular area east of the M42, north of the A45 and west of the A452; and

b. active sand and gravel extraction east of the Scheme.

Agricultural soil resource receptors

10.6.69 The agricultural land in the area of the Scheme (notwithstanding survey limitations) has been identified during the Agricultural Land Classification and Impact Assessment [REF 10-2] to comprise predominantly Grade 3b agricultural land with areas of Grade 3a. The areas of agricultural land which could not be surveyed as part of the ALC survey, has been given a conservative designation of Grade 3a.

Sensitivity of receptors

10.6.70 **Table 10.13** presents the importance/ sensitivity of potential receptors or soil/geological resources to ground conditions impacts.

Table 10.13: Critical receptors and their importance/sensitivity

Receptor	Phase			Importance/ sensitivity
	Construction	Operational	Future maintenance	
Receptors susceptible to land contamination and ground hazard impacts				
Human Health – Off-site receptors	✓	✓	✓	Medium
Human Health – Future site users	x	✓	✓	Low
Human Health – Construction and maintenance workers	✓	✓	✓	Medium

Receptor	Phase			Importance/ sensitivity
	Construction	Operational	Future maintenance	
Controlled Waters – Groundwater (Secondary A and B aquifers and abstractions)	✓	✓	✓	Medium
Controlled Waters – Surface Waters (watercourses and protected drinking water safeguarding area)	✓	✓	✓	Medium
Construction Materials	✓	✓	x	Medium
Surrounding Land Uses – (Grade3a Agricultural Land)	✓	x	x	Medium
Surrounding Land Uses – (Grade 3b Agricultural Land)	✓	x	x	Low
Sensitive Sites (ecological receptors)	✓	✓	x	Medium
Property (residential and commercial properties, agricultural crops, livestock and infrastructure such as below ground utilities)	✓	✓	x	Medium
Soil and geological resources				
Sensitive Sites (minerals safeguarding areas, LGS, active mineral sites)	✓	✓	x	Medium
Agricultural soil resources				
Surrounding Land Uses – (Grades 2 and Agricultural Land)	✓	x	x	Medium
Surrounding Land Uses – (Grades 3b Agricultural Land)	✓	x	x	Low
x - Not considered to be effected				

Ground Investigation - contamination assessment

10.6.71 As part of the Ground Investigation Report [REF 10-39] , AECOM undertook a ground contamination assessment to inform risk to human health and controlled waters, and to summarise ground gas and preliminary waste classification considerations, presented as a Technical Note in Appendix 10.1 [**TR010027/APP/6.3**].

10.6.72 The conclusions of the contamination assessment are presented in Section 9 of the Technical Note in Appendix 10.1 [**TR010027/APP/6.3**], the key findings of which are summarised as follows.

10.6.73 The results of the human health assessment suggested that the chemicals of potential concern (CoPC) identified in soil are not likely to impact on the health of future human receptors, based on the proposed end use as a highway.

10.6.74 In relation to controlled waters, further groundwater monitoring and sampling followed by further assessment of detected CoPC concentrations was recommended. Although further groundwater data will be required to provide a robust controlled waters risk assessment, as a preliminary assessment it was considered that there is potential for the identified leachable concentrations of polycyclic aromatic hydrocarbons (PAHs) to migrate to the identified surface water receptors, however, the risk for this was deemed to be low at this stage due to the proximity of soils with elevated levels of CoPC to surface waters and limited evidence of CoPC reaching groundwater. The potential for CoPC to migrate in sufficient concentrations to impact groundwater in the Secondary 'A' Aquifer in the Glacio-fluvial deposits to the north of the scheme was considered to be low. However, as only four groundwater samples from the Scheme area were tested during the ground investigation to date, it was recommended that the preliminary assessment should be revisited after further groundwater monitoring and sampling has been undertaken, particularly from standpipes installed in the glaciofluvial deposits within the northern part of the Scheme, north of Hollywell Brook.

10.6.75 All samples analysed in the HazWaste assessment were reported to be 'Non Hazardous', except for BH219-17 at 4.2m depth (Made Ground) and BH700-17 at 0.7m depth (Made Ground/Topsoil) which were determined to be Hazardous. It is therefore suggested that in the likely event that soils are generated for waste disposal during construction, further testing and classification would be required based on the actual soils excavated and segregated for disposal, and that any sampling undertaken should be representative and follow the guidance provided in Appendix D of Technical Guidance WM3 (Version 1.1), published by the Environment Agency in May 2018 [REF 10-50].

Conceptual site model

10.6.76 A CSM defines the plausible contaminant source, pathway and receptor linkages, which is integral to defining baseline conditions. The CSM presents details of potential sources of contamination, potential receptors and potential contaminant migration pathways that have been identified for these sites.

10.6.77 **Table 10.14** lists the considered potential sources of contamination associated with the Scheme.

Table 10.14: Potential sources of contamination associated with the Scheme

Potential sources	Description
Made Ground	Limited Made Ground identified within the Scheme during the ground investigation
Soil Leachate	Leachates associated with potential contaminants in Made Ground and potential contamination from historical land uses into soil.
Groundwater	Potential for contaminants in groundwater leaching from Made Ground and potential contamination from historical land uses leaching into groundwater.
Off-site Sources	Potential small scale fuel spillages. Pesticides and herbicides that may have been used during historical agricultural land use.

10.6.78 **Table 10.15** provides a summary of the potential land contamination receptors associated the Scheme.

Table 10.15: Description of potential land contamination receptors

Potential receptors	Description
Future site users	Future users of the Scheme.
Surface waters and/ or groundwater	Surface water features – Holywell Brook, Shadow Brook, River Blythe and other unnamed surface water features. Underlying Secondary A and Secondary B aquifers within the Alluvium, Glaciofluvial Deposits, and Mercia Mudstone Group.
Agricultural soils	Agricultural farmland and produce in the vicinity of the scheme
Off-site receptors	Nearby farms, residential and commercial developments

10.6.79 **Table 10.16** provides a summary of the potential pathways by which contamination sources may come into contact with receptors considered most appropriate for the Scheme route.

Table 10.16: Description of potential contamination pathways

Potential Pathways		Description
Soil pathways for the following sources: Made ground. Soil leachate.	Dermal contact	Direct contact with contaminated ground soils, soil derived dust, soil leachate and perched water in the made ground.
	Ingestion	Direct or indirect ingestion of made ground soil and soil derived dust.
	Inhalation	Inhalation of made ground soil derived dust, organic vapours or ground generated gas.
Groundwater pathways for the following sources: Soil leachate. Groundwater.	Infiltration and vertical migration via permeable strata	Rainfall infiltration can generate and mobilise made ground soil-derived leachate impacting on surface waters and groundwater. Majority of the Scheme would include areas of hard standing which would limit the amount of infiltration at the site.
	Lateral migration through aquifers	Aquifers allow transportation of contaminants through the permeable strata.
Pathways for ground gas	Vertical/lateral migration via permeable strata	Permeable strata and service trenches could potentially allow movement of ground gases.

10.6.80 The potential contaminant linkages and associated risks identified for the Scheme are summarised in **Table 10.17**.

Table 10.17: Potential contaminant linkages

Potential Sources	Pathways	Receptor
Made ground and soil leachate	Inhalation/ingestion of soil derived dust.	Future site users Off-site receptors Controlled waters Agricultural soils
Groundwater	Infiltration and vertical migration via permeable strata. Lateral migration of contaminants through aquifers.	Surface watercourses Underlying groundwater
Off-site sources	Inhalation/ingestion of soil derived dust. Infiltration and vertical migration via permeable strata. Lateral migration of contaminants through aquifers.	Future site users Flora and fauna Off-site receptors

10.7 Potential impacts

10.7.1 The process of scoping identified that the introduction and/or modification of road infrastructure associated with the Scheme would potentially result in different types and durations of impact on water resources, during both the construction and operational phases.

Construction

10.7.2 During construction, in the event of disturbance of contaminated soils/groundwater, there is the possibility that construction may affect human, ecological or controlled waters receptors, and for the ground conditions to impact on the design of the Scheme. The majority of excavated material is expected to comprise inert Murcia Mudstone with no potential contamination, therefore the main risks relate to excavations for cuttings through the topsoil and in areas of known historical landfills.

10.7.3 Potential impacts include but are not limited to:

a. mobilising existing contaminants in soil and groundwater as a result of exposure following ground disturbance and de-watering during construction;

b. increasing the potential for contaminants in unsaturated soils to leach to groundwater in open excavations during construction;

c. increasing the potential for contaminated surface run-off to migrate to surface water and groundwater receptors as a result of contaminant mobilisation from uncovered stockpiles;

d. introducing new sources of contamination, such as fuels and oils used in construction plant and fluids and chemicals used in construction methods;

e. creating preferential pathways for the migration of soil contamination and ground gases, for example, along new below ground service routes, service ducts; and

f. introducing new human health receptors such as site staff/construction workers during construction.

10.7.4 Construction activities can also result in physical damage to soil, including the excavation and temporary storage process for the proposed cuttings, soil compaction as a result of heavy construction vehicle movements and the exacerbation of soil erosion through handling and storage of soils.

Operation

10.7.5 During the operational stage of the Scheme, conditions may have altered from the baseline as a result of, but not limited to:

a. introducing road users, operational maintenance staff and the road infrastructure as new receptors;

b. contamination which has been encountered having been removed or remediated;

c. revised road drainage and discharge routes to be directed towards new highways drainage systems; and

d. improvement in surface water runoff quality as a result of additional treatment compared to existing conditions.

10.8 Design, mitigation and enhancement measures

10.8.1 The Scheme has been designed, as far as possible, to avoid and minimise impacts and effects on the geology and soils environment through the process of design-development (see Chapter 4 Scheme history and alternatives), and by embedding measures into the design of the Scheme.

10.8.2 A number of standard measures have been identified, which would be implemented by the Contractor to reduce the impacts and effects that construction of the Scheme would have on geology and soil receptors.

10.8.3 No compensation or enhancement measures have been identified as being required.

Embedded mitigation

10.8.4 The mainline link road has been designed to minimise the potential for interacting with known contaminated land, so thus reduce the likelihood for disturbance.

10.8.5 Given the semi-rural natural of the Scheme's setting, the extent of land take to construct the Scheme has been designed to minimise the overall footprint so as to reduce the loss of agricultural soils.

10.8.6 The possibility of cut/embankment slopes being susceptible to erosion have been reduced through design, by means of drainage and appropriate gradient of cutting slopes, primarily around the mainline link road where cutting would be at a gradient of 1:3 to 1:25.

10.8.7 The long term risk associated with corrosive chemical attack on infrastructure will be further considered during detailed design; however, the broad design principles of appropriate construction material use has been applied to the Scheme, for example, the construction of the new Solihull Road overbridge and the new pedestrian overbridge over the A45 at Church Lane.

Standard mitigation

10.8.8 The Outline Environmental Management Plan (OEMP) [**TR010027/APP/6.11**] details the measures that would be undertaken during construction of the Scheme to mitigate temporary effects on geology and soil receptors.

10.8.9 These measures broadly focus on:

a. the management of construction activities with the potential for generating for contamination through run-off/accidental spillage or by disturbance of in-situ materials;

b. the management of excavated materials as a result of construction works; and

c. the management of human receptors associated with the construction workforce.

10.9 Assessment of significant effects

10.9.1 The prediction of impacts and the assessment of effects has taken account of the embedded and standard mitigation measures identified within Section 10.8.

Construction effects

Geological site designations

10.9.2 There are no geologically designated sites identified within the Scheme. However, Nursery Cottage, (Arden) Brickworks (also known as 'Jackson's (Warwickshire)') is a LGS located within the study area (approximately 230m from the Scheme). It is considered as medium sensitivity and a magnitude of very low has been identified in this regard. The resulting effect upon designated geological sites during the construction phase that is considered to be of negligible (not significant).

Mineral site designations

10.9.3 There is a Mineral Safeguarding Area located within the Scheme and the geology study area as defined by both the SMBC and WWC mineral plans. This is located within the triangular area of land bound by the M42, A45 and A452 at the north-east of the Scheme. Therefore, there is the potential for severance or sterilisation. However, based on the SMBC Draft Local Plan Review Proposals Map [REF 10-22] this area is proposed to be allocated as mixed use and is also traversed by the potential HS2 line. Therefore, it is unlikely to be of regional or nationally significant mineral reserves. A medium sensitivity and magnitude of impact of low to very low has been identified. A low to very low magnitude of impact has been given as the road construction elements in this area are adjacent to the current M42 and A45. Also, the SMBC draft proposals indicate allocating this land as mixed used, suggesting limited importance of this mineral resource. This results

in an overall effect upon mineral resources that is considered to be minor (adverse) to negligible (not significant).

Human health

Construction workers

10.9.4 It is a requirement of the appointed Contractor that risk assessments will be undertaken before construction activities commence, in full accordance with the Health and Safety at Work Act [REF 10-51] to restrict and manage any potential exposure to harmful substances. Potential impacts specific to construction workers are expected to be mitigated through the appropriate specification and use of Personal Protective Equipment (PPE) and the implementation of site controls and procedures in accordance with the Principal Contractor's Construction Phase Plan, as required under the Construction (Design and Management) Regulations 2015 [REF 10-52].

10.9.5 Construction workers are considered to have a medium sensitivity. The potential magnitude of harm occurring to human health is defined as very low taking into consideration the adoption of standard PPE and site controls which are a prerequisite to construction. The potential effects upon construction workers would be limited for the duration of the construction phase activities. This results in an effect upon health of construction workers during the construction phase that is considered to be negligible (not significant).

Off-site receptors: neighbouring site users, occupiers and the general public

10.9.6 Neighbouring residential and commercial human receptors identified within the study area are assigned a medium sensitivity. This considers relative exposure duration between a resident (continuous) and an employee (working hours), together with the proximity of each type of receptor from the construction works. Given the results of the human health assessment undertaken as part of the ground investigation report, the magnitude of impact on human health resulting from exposure to soil dusts and/or uncontrolled run off is defined as low. As such, provided good construction practices detailed in Section 10.8 are adopted and implemented, the overall effect from the uncontrolled release of potentially contaminated soil-derived dust or run-off upon the health of neighbouring site users, occupiers and the general public during the construction phase is considered to be minor adverse (not significant).

10.9.7 The overall effect on the neighbouring site users, occupiers and the general public is considered to be negligible (not significant).

Controlled waters

Groundwater (Secondary A and B aquifers)

10.9.8 For land contamination, construction effects have the potential to be adverse in respect of mobilising existing contamination but post-construction there is the potential for a beneficial effect to be realised if land contamination has required removal/ remediation.

10.9.9 A qualitative assessment of impacts from or to, soil and groundwater contamination, from the Scheme has been undertaken for the construction and operational phases. Foundations associated with any bridge construction could provide a preferential pathway for contaminants to migrate to non-contaminated soils and subsequently into groundwater throughout the construction period. However, any contamination encountered during construction would be expected to be removed, treated and/or mitigated as part of the construction process and before foundations were constructed.

10.9.10 Potential dewatering of excavations may be required which would generate a quantity of groundwater that would need to be managed and discharged appropriately from the site. An abstraction licence is required when abstracting more than twenty m^3/day. Where discharges from site are uncontrolled this could result in pollution of the receiving waters, which may impact on surface water quality. If too much water is discharged, or the discharge rate is too high in the absence of sufficient controls, the capacity of the receiving surface water environment could be exceeded which may cause flooding off site in the wider area. The proposed mitigation measures are discussed in Chapter 14 Road drainage and the water environment. The discharge of groundwater will require an environmental permit from the EA.

10.9.11 As such, the nearest active groundwater abstraction is considered to be situated at Common Farm, used for general farming and domestic purposes. Although this well is situated approximately 120m to the north-east of the Scheme, the potential exists for dewatering activities to affect the water supply in this well. However, given the depth to groundwater and lower permeability of the bedrock geology (mainly secondary B aquifer) significant quantities of dewatering is not anticipated.

10.9.12 Taking into consideration the medium sensitivity of the aquifer (Secondary A and Secondary B), and the potential magnitude of the impact considered to be low, the overall effect on groundwater resource is considered to be minor adverse (not significant).

Surface water

10.9.13 The prevention of pollution of surface waters would be achieved via the standard construction mitigation measures as outlined in Chapter 14 Road drainage and the water environment and discussed further in the OEMP [**TR010027/APP/6.3**]. The mitigation measures aim to manage the surface water run-off from the construction site (site preparation, earthworks and construction activities) to reduce as far as practicable the potential for impacts to receiving watercourses.

10.9.14 Surface water features are of medium sensitivity, and the potential magnitude of the impact is considered to be low. As such, the overall effect is therefore assessed to be minor adverse (not significant).

Construction materials

10.9.15 In terms of potential degradation of buried concrete from the ground conditions, risks to the Scheme will be adequately mitigated through the adoption of an appropriate design of concrete class that will be specified in accordance with the Building Research Establishment (BRE) Special Digest 1 [REF 10-53].

10.9.16 The proposed construction materials and below ground services are considered to be receptors of medium sensitivity and the magnitude of impact is considered very low. As such, the overall effect of geology and soils on construction materials and below ground infrastructure is considered to be negligible (not significant).

Ground stability

10.9.17 Earthworks including excavations and any potential foundations associated with bridge structures for example, together with any dewatering that may be required, could adversely affect ground stability and, subsequently, any proposed and surrounding structures through uncontrolled settlement. There may be a requirement to provide temporary support for site excavations. Such support may include benching of excavations, shoring or the construction of retaining walls (such as sheet piles) or struts to mitigate the risk of settlement or excessive spalling. It is expected that the need for such control would be established during detailed design and where specified and implemented correctly, would be sufficient to mitigate the impacts generated.

10.9.18 It is considered that any settlement of land would represent a low magnitude of change to land stability, which is of low sensitivity given the general absence of development that might be affected. Therefore, the effect on land stability as a result of construction activities has been assessed as negligible (not significant).

Agricultural land

10.9.19 The construction of the Scheme would result in the loss of approximately 21.4ha of Grades 3a and approximately 82ha of 3b agricultural land classifications. Although the loss of agricultural land cannot be totally avoided, measures were taken to minimise to loss of agricultural land as part of the iterative design process.

10.9.20 Grade 3a agricultural land is classed as BMV and these have medium sensitivity. **Table 10.2** indicates that the magnitude of impact for the loss of between 20ha and 50ha of BMV agricultural land is medium. Therefore, the effect of the Scheme on Grade 3a agricultural land is assessed to be moderate adverse (significance).

10.9.21 Grade 3b agricultural land is not classed as BMV and as a result has a low sensitivity. The magnitude of impact for the loss of any quantity of land not considered ‘best and most versatile’ agricultural land is low. Therefore, the effect of the Scheme on Grades 3b agricultural land is assessed to be negligible (not significant).

Operational effects

10.9.22 The Scheme operation would not include any activities that are likely to generate contaminants that could pose significant risk to controlled waters. However, there would be potential for environmental risks as associated with spillages due to road accidents or faulty vehicles.

10.9.23 Drainage would be attenuated during the operation phase of the Scheme using drainage attenuation tanks. The potential for contaminated surface water to infiltrate into the ground would be reduced as a result once the Scheme is operational.

10.9.24 Scheme drainage solutions have been designed such that potential operational impacts on hydrogeological conditions associated within the Scheme would not be generated. Details of the drainage solutions are presented in Chapter 14 Road drainage and the water environment.

10.9.25 There are not expected to be any longer term, operational or permanent impacts on geology resulting from the operation of the Scheme.

10.9.26 Future users of the Scheme would be transient in nature and therefore unlikely to interact with the underlying ground conditions or hydrogeology.

10.9.27 As such, the overall effect of geology and soils on all identified receptors during the operation phase of the Scheme is considered to be negligible (not significant).

10.10 Monitoring

10.10.1 The assessment of effects presented in Section 10.9 and summarised **Table 10.18** indicates that with the exception of agricultural land, no other significant adverse effects relating to geology and soils has been identified. Therefore, there is no requirement for monitoring of adverse effects.

10.10.2 Where temporary loss of or damage to agricultural land has occurred during the construction, monitoring will be required to ensure the affected land is restored to agricultural use. The requirements for soil reinstatement, monitoring, and aftercare is detailed in the outline Soil Management Plan as presented within Appendix 3.1 of the OEMP [**TR010027/APP/6.11**].

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