

Routes to Market – Delivery Integration Partnership

M25 Junction 10 / A3 Wisley Interchange Improvement

Piling Risk Assessment

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1. Introduction

- 1.1.1. Highway England's proposed improvements to the M25 junction 10/A3 Wisely Interchange (herein referred to as the Scheme) are designed to provide additional capacity at M25 junction 10 and to the north and south of the A3. The upgrades include the construction of numerous bridges, gantries and retaining walls throughout the Scheme that involve piling. To support the design and development of the scheme in accordance with the commitments and requirements detailed in the Register of Environmental Actions and Commitments (REAC) [1], Environment Statement (ES) [2] [3], and Development Consent Order (DCO) [4], which are outlined in Table 1-1, Atkins was commissioned by Highways England to undertake a piling risk assessment (PRA) to assess the potential controlled water risks associated with the proposed piling works at structures within the Scheme. A Scheme location plan is provided below in Figure 1-1.

Table 1-1 - REAC, ES and DCO commitments and requirements

Environmental Objective	REAC reference	ES reference	DCO reference
Prevent adverse effects on groundwater flow (road drainage and water environment)	RD1.16	Ch 8, section 8.9	-
Prevent pollution of aquifers and prevent pollution of surface waters (geology and soils)	GS1.8	Ch 10, section 10.9	Schedule 2, Part 1 (Requirements), Article 4, Sections 10 and 13

Figure 1-1 - Scheme location plan



1.2. Background and Objectives

- 1.2.1. The objective of this report is to assess the potential risks to controlled waters¹ and human health from piling activities associated with the J10 upgrade scheme. This assessment uses the piling design to determine the locations, depths and types of piling that will occur throughout the Scheme and has been undertaken in line with Environment Agency (EA) guidance [5].

1.3. Limitations

- 1.3.1. The conclusions and recommendations of this report are based on the data obtained and design details available at the time of writing.
- 1.3.2. The conclusions of this report are based partly on the findings of the assessment of data taken from exploratory holes advanced within M25/J10 as part of ground investigations (GIs) and from information obtained from a variety of sources, including documents provided by third party sources that are assumed to be reliable. Nevertheless, Atkins cannot and does not guarantee the authenticity or reliability of third-party information. No attempt has been made to verify independently any data collected by others.
- 1.3.3. Data collected from exploratory holes are based on point sources and variation can occur between sampling points. Therefore, this report cannot guarantee against unexpected ground conditions occurring between the sampling points.

¹ Controlled Waters: As defined in the Water Resources Act (1991)

2. Summary of Ground Conditions

- 2.1.1. Highways England appointed Geoffrey Osborne Ltd (Osborne) as Principal Contractor who in turn appointed SOCOTEC to carry out the Ground Investigation (GI) in 2019 and 2020. The findings from the GI were reviewed and assessed within the Ground Investigation Report (GIR) [6] and the GIR Addendum [7]. This PRA includes a summary of the ground conditions encountered during the investigation with this section outlining a summary of the geology, soil and hydrogeology conditions of the Scheme based on available information.

2.2. Site Setting

- 2.2.1. The majority of the Scheme area is currently occupied by the existing M25, A3 and various side roads. The remainder of the land within the Scheme boundary includes agricultural land, woodland and lakeside recreational areas, and part of the former Wisley Airfield. The surrounding area comprises of woodland and recreational public space, farms, a railway, agricultural land, the former Wisley Airfield, and some mixed development including residential and commercial land uses.
- 2.2.2. There are no geological Sites of Special Scientific Interest (SSSI) within the Scheme boundary. However, there are several statutory designations of sensitive environments within and adjacent to the Scheme, which are:
- Ockham Common and Wisley Common SSSI, which is also part of the Thames Basin Heath Special Protection Area (SPA);
 - Ockham and Wisley Local Nature Reserve (LNR), which is also a designated wood pasture and parkland Biodiversity Action Plan (BAP); and
 - Ancient Woodland and Priority Habitat deciduous woodland.
- 2.2.3. The environmental constraints of the Scheme are shown in Appendix A.

2.3. Current Ground Conditions

- 2.3.1. The site extends over a large area and the geological sequence encountered during the 2019-2020 GI broadly corresponded with published geological information / historical borehole data. BGS 1:50,000 geological mapping of superficial geology is shown in Figure 2-1 and bedrock geology in Figure 2-2.
- 2.3.2. The Scheme generally comprises Artificial Ground underlain by superficial deposits of Alluvium (sandy or silty clay) and Undifferentiated River Terrace Deposits (generally fine to coarse gravels) which, where present, overlie bedrock geology comprising Swinley Clay Member (stiff mottled laminated clay), Bagshot Formation (fine to coarse grained material) and Claygate Member (stiff to very stiff dark grey silty clay). The top of the Claygate Member defines the upper boundary of the London Clay Formation. In places, there are no superficial deposits and the bedrock geology is at the surface. A summary of geological conditions encountered during the GI is presented below in Table 2-1, which also presents Environment Agency aquifer designation.
- 2.3.3. Artificial Ground is a term used to describe areas where the ground surface has been significantly modified by human activity, which in the Scheme comprise of Made Ground, Engineering Fill and Landfill. Made Ground is found in localised areas throughout the Scheme; Engineering Fill is predominantly found beneath the existing carriageway and at embankments; and Landfill is found in at the former Wisley Airfield and Old Rectory Farm landfills in the south of the Scheme, and at the landfill east of Buxton Wood in the west of the Scheme.

- 2.3.4. Superficial deposits are not continuous throughout the Scheme, with the Alluvium only present at the southernmost part of the Scheme, associated with Stratford Brook, and the River Terrace Deposits found in localised areas. Although not identified in the GI, BGS geological mapping shows superficial deposits of the Kempton Park Gravel at the west of the Scheme; Taplow Gravel in the east; and Lynch Hill Gravel Members at the north, west and south of the Scheme.
- 2.3.5. Whilst not shown in BGS bedrock geological mapping, the Swinley Clay Member was identified in ground investigation boreholes adjacent to the A3 for approximately 500 m north of Junction 10. The Bagshot Formation is the predominant formation present across the Scheme, and the Claygate Member is also found throughout the Scheme at deeper depths. The thickness of the Claygate Member was not proven during the GI. The greatest thickness encountered was 14.33 m in borehole 1-235; however, the depth to base was not proven.
- 2.3.6. The extent of these strata, including aquifer designation, the extent of artificial ground, and potential sources of contamination are shown in Appendix B.

Figure 2-1 – BGS 1:50,000 superficial geological map

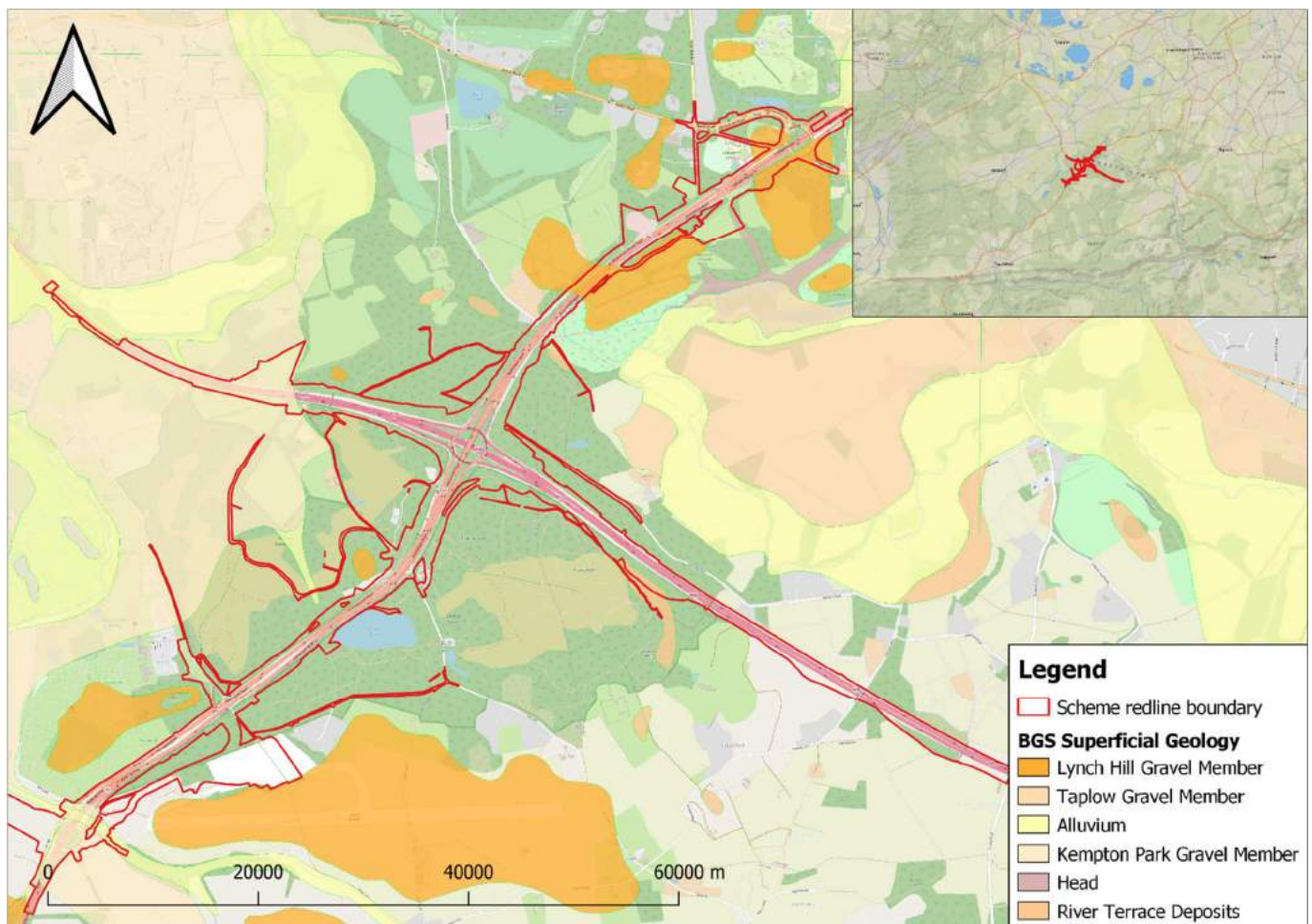


Figure 2-2 - BGS 1:50,000 bedrock geological map

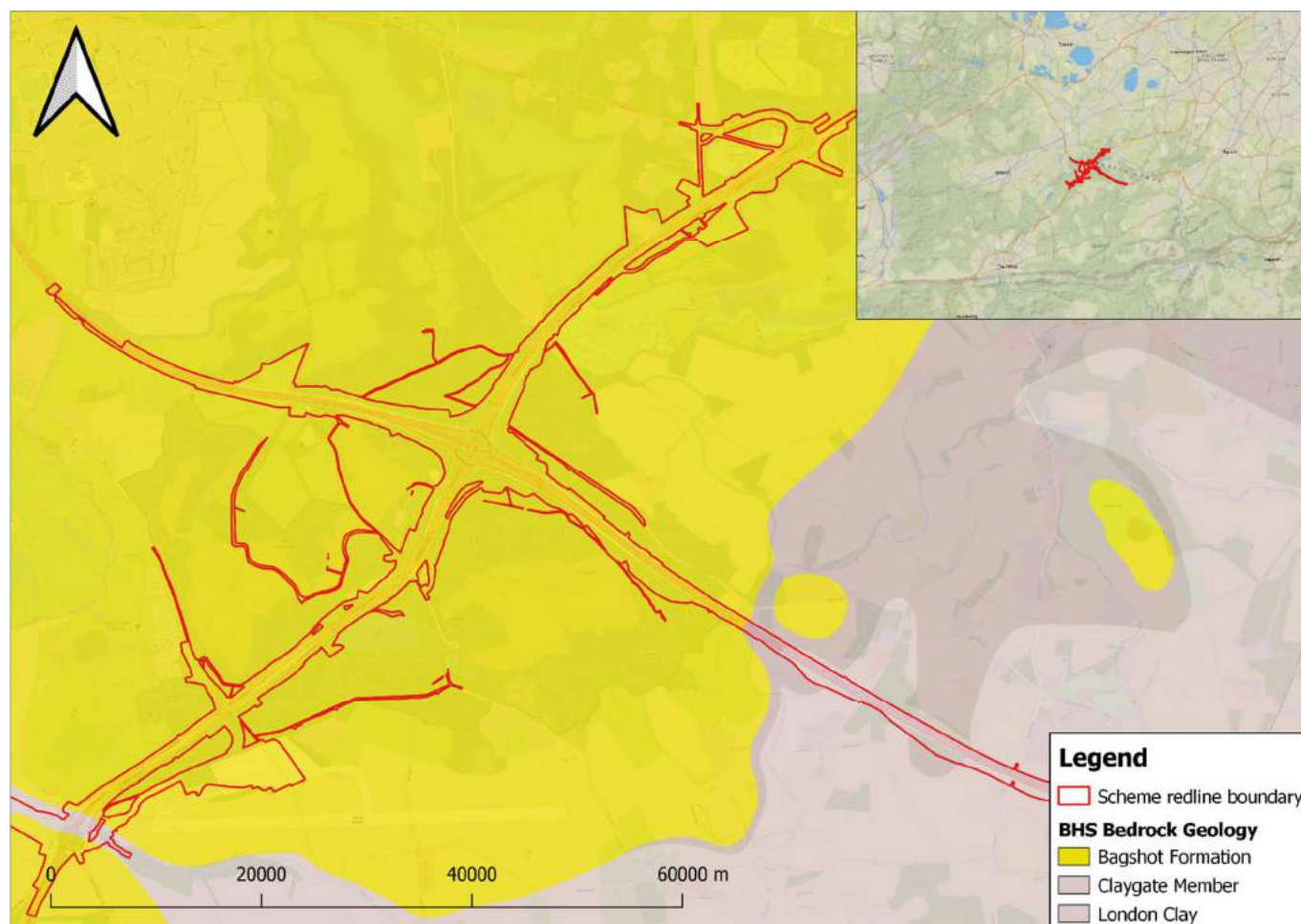


Table 2-1 - Summary of geological conditions encountered during the GI.

Stratum		Thickness (m)	Top of Stratum Level Range (m AOD)	Base of Stratum Level Range (m AOD)	Aquifer Designation
Topsoil		0.05 to 1.1	22.8 to 54.3	22.4 to 53.7	Not applicable
Artificial Ground	Made Ground	0.04 to 4.1	16.9 to 49.9	16.9 to 49.9	Not applicable
	Engineered Fill				Not applicable
	Landfill				Not applicable
Superficial Deposits	Alluvium	0.4 to 2.5	18.8 to 22.2	18.1 to 19.7	Secondary A
	Undifferentiated River Terrace Deposits	0.3 to 5.7*	19.1 to 34.5	14.1 to 34.1*	Secondary A
	Kempton Park Gravel Member ^	N/A	N/A	N/A	Principal / secondary A
	Taplow Gravel Member ^	N/A	N/A	N/A	Principal
	Lynch Hill Gravel Member ^	N/A	N/A	N/A	Secondary A
Bedrock	Swinley Clay Member	0.7 to 15.6	24.7 to 53.7	24.2 to 50.8	Unproductive strata

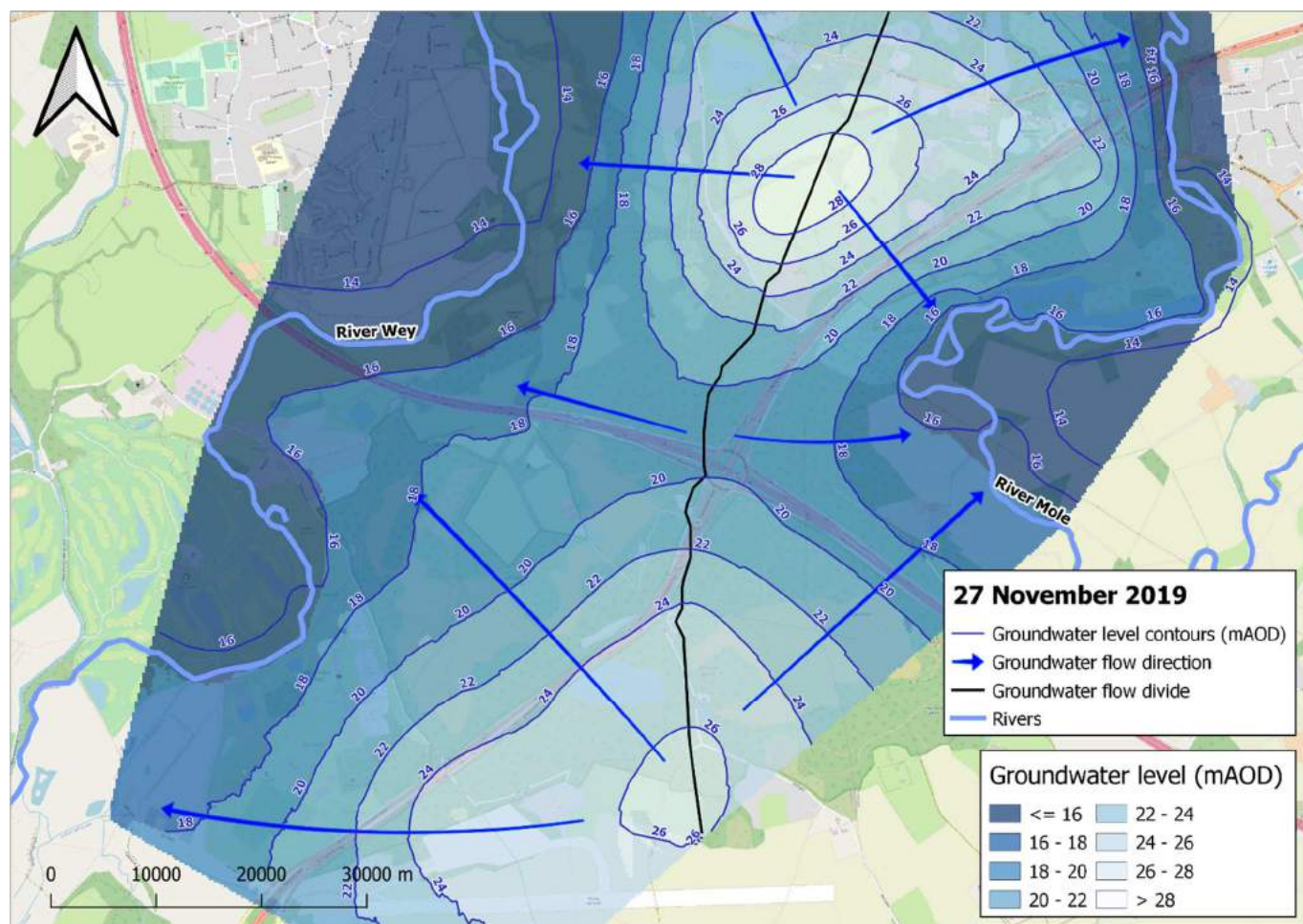
Stratum		Thickness (m)	Top of Stratum Level Range (m AOD)	Base of Stratum Level Range (m AOD)	Aquifer Designation
	Bagshot Formation	7.0 to 29.0*	-2.0 to 44.1	-3.2 to 11.4*	Secondary A
	Claygate Member (London Clay)	>14.3*	-7.0 to 12.7	unproven*	Unproductive strata

* Depth to base not proven

2.4. Hydrogeology conditions

- 2.4.1. Groundwater level monitoring was carried out during the GI and was reported in the GIR [6]. The hydrogeological flow regime is understood to consist of higher hydraulic conductivity aquifer units overlying the deeper low hydraulic conductivity London Clay Formation. The low permeable London Clay Formation is considered to form an aquitard between the shallow groundwater in the superficial and bedrock deposits outlined above in Table 2-1 and deeper units (e.g. Chalk Group). For the purpose of this report and due to the hydraulic link between geological units, the groundwater above the London Clay Formation will be considered as a singular aquifer.
- 2.4.2. Groundwater present within the development area will preferentially migrate within aquifer units. Whilst some clay dominated strata (the Swinley Clay Member and Claygate Member) are classified as unproductive strata, the presence of fissured clay and/or occasional silt or sand lenses/partings in those units may act as conduits for the transmission of groundwater. Localised faulting may also act as a pathway for groundwater.
- 2.4.3. During the most recent GI, the Bagshot Formation (secondary A aquifer) was encountered with proven thicknesses of between 7 m and 29 m and was confirmed as laterally continuous. The Bagshot Formation aquifer is considered to be hydraulically linked to the superficial aquifers and are in turn hydraulically connected to both the River Wey and River Mole. Groundwater is generally unconfined within the Bagshot Formation, even where the Swinley Clay Member is present. The Bagshot Formation contains interbedded clay lenses that are relatively thin, laterally discontinuous and locally broken, and which are not considered aquitards.
- 2.4.4. Groundwater elevation data were collected during the 2019/2020 GI and were recorded between approximately 16 m and 26 m Above Ordnance Datum (AOD) in the Bagshot Formation. Localised high groundwater levels were associated with laterally discontinuous perched water sitting on the Swinley Clay Member.
- 2.4.5. The conceptual understanding presented in the GIR indicates the presence of a surface water and groundwater flow divide beneath Junction 10, with the divide in groundwater flow running approximately north-south directly beneath the junction. Groundwater topographic highs are found along this flow divide in the centre of the site with groundwater flowing away from the A3 towards either the River Wey or River Mole. Groundwater around Boulder Mere, located in the south of the Scheme, flows northwest to the River Wey. A groundwater contour map derived from monitoring conducted on 17 November 2019 is shown in Figure 2-3.

Figure 2-3 - Groundwater contours derived from monitoring undertaken on 17 November 2019



2.5. Groundwater Resource Potential

- 2.5.1. The Scheme is not located within a groundwater Source Protection Zone (SPZ). The closest SPZ is located approximately 3.8 km north west of the Scheme and it is considered unlikely that groundwater within the shallow aquifer would be used as a public water supply within or in proximity to the Scheme. The presence and thickness of London Clay at the base of the shallow aquifer indicates that groundwater is considered hydraulically disconnected from deeper geological units. Groundwater across the scheme is considered as having moderate sensitivity.

2.6. Environmental Receptors

- 2.6.1. Several watercourses are located within the Scheme:
- the River Mole, which is located to the east of Junction 10 and passes under the A3 at the north-east of the Scheme;
 - the River Wey, and associated tributaries, to the west of the Junction 10, including Stratford Brook, which passes beneath the A3 at the south-west of the Scheme;
 - Bolder Mere (a lake of approximately 5.1 ha), situated in Ockham Common approximately 800 m to the south-west of the Junction 10;
 - a pond in Chatley Wood, situated approximately 350 m to the east of the Junction 10;
 - and Guilehill Brook, which passes under the A3 approximately 3.6 km to the south of the Junction 10 and is located outside of the study area boundary.
- 2.6.2. There are several smaller surface water features present within the study area, including small ponds and the Lake adjacent to Painshill Park. Whilst the River Mole, the River Wey, and Bolder Mere lake are the primary surface water receptors, the risk assessment will consider the specific risks in proximity to both the smaller and primary surface water receptors.
- 2.6.3. Groundwater Receptors are considered to be the groundwater within the shallow aquifer beneath the site, the principal component of which is the Bagshot Formation.
- 2.6.4. Due to the piling activities taking place over a large extent of the Scheme, the sources, pathways and receptors will be assessed on a structure-by-structure basis.

3. Chemical Conditions

- 3.1.1. Contemporary and historical sources of ground contamination with the potential to impact groundwater quality have been identified and reported within the GIR and are shown on Appendix B. A controlled waters Generic Quantitative Risk Assessment (GQRA) was undertaken and reported within the GIR Addendum [6]. Potential sources have been identified and are presented below:
- Made Ground/infill material of unknown quality associated with the construction existing infrastructure;
 - material of unknown quality associated with the infilling/potential infilling of former water features and mineral extraction pits;
 - eight recorded pollution incidents (minor severity and occurred prior to 1999);
 - area of the former Wisley Airfield and associated activities (historical GI identified some contamination);
 - farms and agricultural land use;
 - the railway to the south-east of Junction 10;
 - historical pollution incidents from vehicles using the current M25, A4, A245 and local access roads;
 - five historical landfills; and
 - potentially contaminative land uses (current and historical), including vehicle service stations, electricity substation, sewage treatment, gas works, asphalt and coated macadam laying contractors, garden machinery services, vehicle dealers, wood and furniture polishers, picture frame renovators, pest control service, small business park and stationery printers.
- 3.1.2. During the GI, soil, soil leachate and groundwater samples were collected throughout the scheme, and surface water samples were collected from a River Wey tributary, Bolder Mere and the River Mole. These samples were submitted for chemical testing for a range of organic and inorganic geo-chemical parameters and the results were screened against relevant Generic Assessment Criteria (GAC) for controlled waters. In addition to sampling, three rounds of ground gas monitoring were conducted to determine the risk of ground gas to human health.
- 3.1.3. The soil results reported concentrations of all analytes below the adopted human health GAC criteria, with the exception of one detection of benzo(a)pyrene and one minor exceedance for nickel. No asbestos containing material was detected in the samples which underwent laboratory testing. Based on the results of the GI, no unacceptable risk to human health receptors were identified.
- 3.1.4. Soil-derived leachate results recorded concentrations above the controlled waters GAC for ammoniacal nitrogen, cyanide, cadmium, hexavalent chromium, cobalt, iron, lead, manganese, nickel, vanadium and zinc. Groundwater results recorded concentrations above the GAC for ammonia, ammoniacal nitrogen, ammonium, chloride, cadmium, hexavalent chromium, iron, sodium, nickel, zinc, benzo(a)pyrene, fluoranthene and chloroform. Overall, it was concluded that the detected concentrations in the soil derived leachate and groundwater are commensurate with that expected in background concentration of an urbanised area and no specific source-pathway-receptor (S-P-R) linkages were identified, resulting in risks to controlled waters being established as low.
- 3.1.5. The ground gas risk assessment evaluated the gas concentrations at each monitoring borehole along with a worst-case scenario using maximum recorded values across all boreholes and monitoring rounds. These were then presented as Characteristic Situations (CS), which define the risk to human health. The calculated implied CS with respect for methane and carbon dioxide were either CS1 (very low risk) or CS2 (low risk) in all monitoring installations. The maximum implied CS for the worst-case scenario was CS2. Therefore, it was considered that the Scheme is unlikely to result in an unacceptable risk to construction workers, future maintenance workers or off-site human health receptors.

4. Proposed Piling

4.1.1. The piling requirements are linked to specific structures/works phases, involving the construction of retaining walls, gantries, and bridges. The details of the structures/work phases are provided in Table 4-1. The locations of piles for retaining walls are shown on Appendix C, gantries on Appendix D, and bridges on Appendix E. While the detained design has not yet been finalised, preliminary design and locations are provided within the Development Consent Order (DCO) [8]. Likewise, the detailed design of the sheet pile walls have not yet been finalised; however, the expected maximum depths, locations and associated cross-sections of geology are provided in Appendix F.

Table 4-1 - Details of proposed piling requirements

Structure	Piling Method	Structure ID	Maximum Depth of Piles (m bgl)	Maximum Pile Diameter	Installation Geology	
					Superficial	Bedrock
Retaining Wall	Sheet piles	Wisley Retaining Wall	4 - 5	N/A	-	BS
		Hut Hill Retaining Wall	8 - 10	N/A	-	BS
		Wisley Interchange Retaining Wall B	5	N/A	MG	BS
		Wisley Interchange Retaining Wall C	5	N/A	MG	BS
		M25 East of Junction (East Bound)	10 - 12	N/A	-	BS
		M25 East of Junction (West Bound)	10 - 12	N/A	MG	BS
Gantry	CFA piles	M25_GN01_EB	25	1.2m (0.9m/0.75m likely)	MG	BS / CM
		M25_GN01_WB			MG	BS / CM
		M25_GN02_EB			-	BS
		M25_GN02_WB			-	BS
		M25_GN05_EB			-	BS / CM
		M25_GN05_WB			-	BS / CM
		M25_GN06_EB			RTD	BS
		M25_GN06_WB			RTD	BS / CM
		M25_GN07_EB			MG / RTD	BS / CM
		M25_GN07_WB			RTD	BS / CM
		A3_GN01_SB			MG	BS
		A3_GN01_NB			-	BS
		A3_GN02_NB			RTD	BS
		A3_GN03_SB			MG / RTD	BS
		A3_GN04_SB			-	BS
		A3_GN04_NB			-	SWC / BS
		A3_GN05_SB			-	SWC / BS
		A3_GN05_NB			-	SWC / BS
		A3_GN06_SB			-	SWC / BS
		A3_GN06_NB			-	SWC / BS
		A3_GN08_SB			-	BS
		A3_GN08_NB			-	BS
		A3_GN09_CR			-	BS

Structure	Piling Method	Structure ID	Maximum Depth of Piles (m bgl)	Maximum Pile Diameter	Installation Geology	
					Superficial	Bedrock
		A3_GN09_NB			-	BS
		A3_GN10_SB			-	BS
		A3_GN10_NB			-	BS
		A3_GN12_SB			RTD	BS
		A3_GN13_NB			RTD	BS
		A3_GN14_SB			MG / RTD	BS
		A3_GN15_SB			MG	BS
Bridges	CFA piles	Clearmont Overbridge	25	1.2m (1.05m likely)	RTD	BS / CM
		Redhill Overbridge			-	SWC / BS
		Sandpit Hill Overbridge			-	BS
		New J10 Bridges			MG	BS
		Cockrow Overbridge			-	BS
		Wilsey Lane Overbridge			RTD	BS
		Stratford Brook overbridge			RTD	BS
<u>Abbreviations</u> MG: Made Ground / RTD: River Terrace Deposits (undifferentiated) / SWC: Swinley Clay Member / BS: Bagshot Formation / CM: Claygate Member						

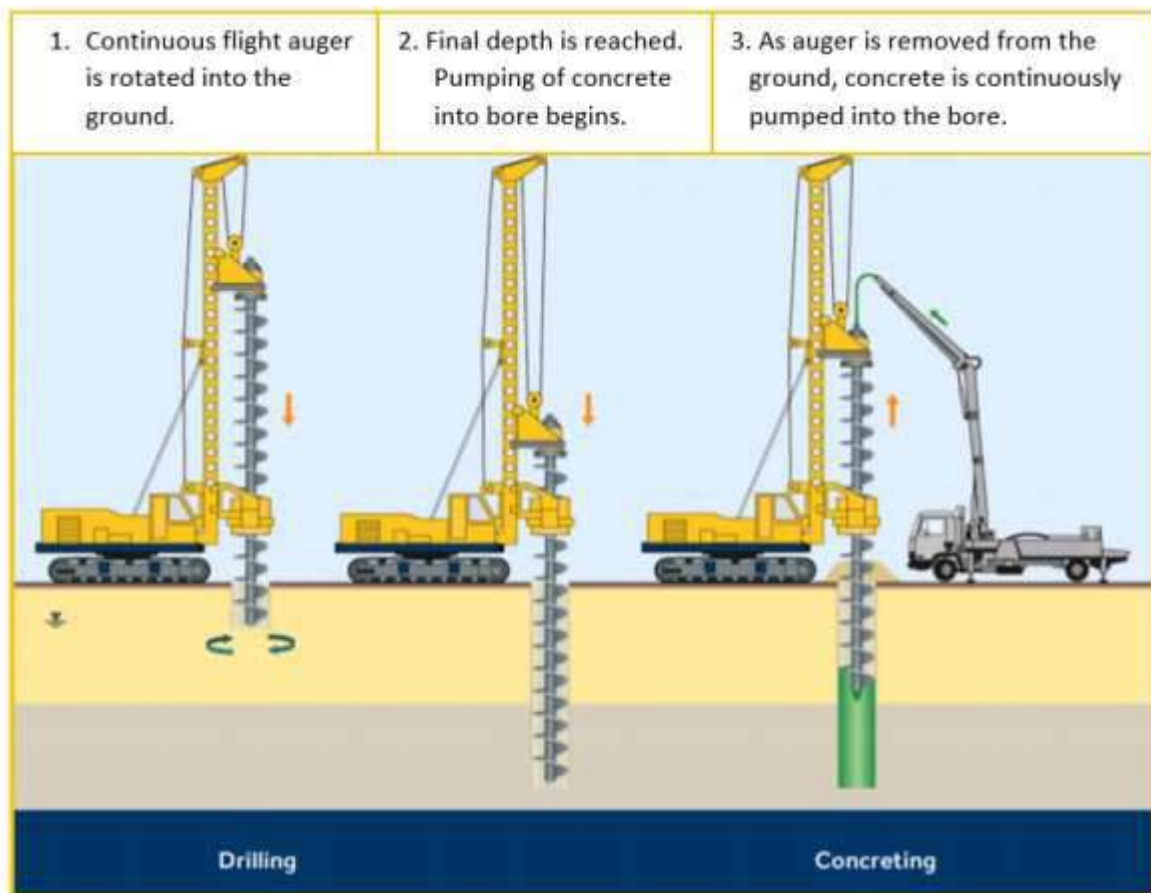
4.2. Piling Methodologies

4.2.1. A description of the piling methodology that will be used in the Scheme structures/works phases are provided below.

4.2.2. Continuous Flight Auger

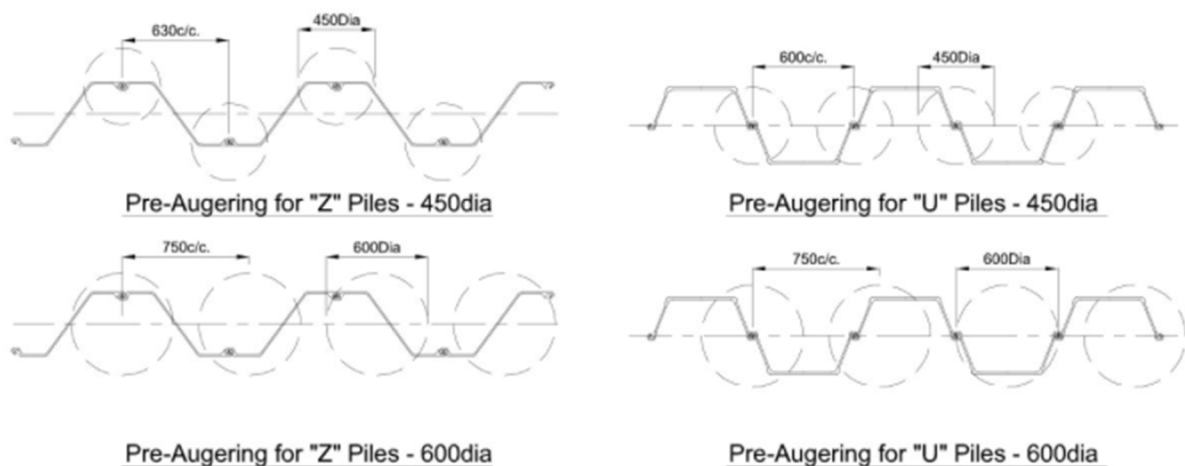
4.2.3. The piles required for gantries and bridges will be drilled using a continuous flight auger (CFA) method. A CFA will be rotated into the ground to the required depth at the desired pile location. Concrete will then be pumped into the bore, through the auger, whilst the auger is being withdrawn from the ground. Once the bore is full of concrete, the auger is removed and the piling rig will then move to the next pile location. The methodology is depicted in Figure 4-1.

Figure 4-1 - Stages of constructing soft piles using CFA piling.



- 4.2.4. CFA piles are considered a non-displacement method with excavated soil removed as arisings followed by piles cast in-situ within the ground. Non-displacement piling methods reduce the risk of moving impacted soils into the aquifer.
- 4.2.5. It has been assumed that control of potentially contaminated arisings will be undertaken as standard across the whole Scheme.
- 4.2.6. **Sheet Piling**
- 4.2.7. The piles required for the retaining walls within the Scheme will be constructed using a driven sheet pile method. Sheets will be hydraulically driven into the ground at a depth approximately two to three times the height of the retaining wall. Whilst the depth varies according to ground conditions and proximity to sloping ground, it is expected that sheet piles will not be driven deeper than 12 metres below ground level (m bgl). As the sheet piles utilise a driven piling method, any contamination in the soils through which the sheets are driven have the potential to be mobilised deeper along with the piles.
- 4.2.8. It is possible that some locations will require pre-auguring to loosen the soil, depending on ground conditions. If this is required, the augur will be screwed in and then back out without removing any soil, just loosening it by the volume of the auger. The typical pattern of pre-auguring is shown in Figure 4-2.

Figure 4-2 - Typical pattern of pre-auguring



5. Piling Risk Assessment

5.1. Methodology

- 5.1.1. The piling risk assessment has been completed according to the methodology and framework set out in the EA guidance on piling on contaminated land [5]. The guidance considers the potential hazards associated with piling and ground improvement works in the context of the environment in which the works will take place. An unacceptable risk of pollution can only occur if the ground works have the potential to create pathways for contaminant migration between a source of contamination and a receptor that could be harmed by exposure to the contaminants, which is termed a Source-Pathway-Receptor (S-P-R) linkage. Each pollution scenario has been assigned a risk rating in accordance with guidance [9], as summarised below:
- very high - There is a high probability that severe harm could arise to a designated receptor or there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability.
 - high - Harm is likely to arise to a designated receptor. Realisation of the risk is likely to present a substantial liability.
 - medium - It is possible that harm could arise to a designated receptor. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild.
 - low - It is possible that harm could arise to a designated receptor, but it is likely that this harm, if realised, would be mild.
 - very low - The possibility of harm to the designated receptor is either not plausible or, if the possibility of harm is plausible, risk is very unlikely given attenuation along the exposure pathway.
- 5.1.2. Where mitigation measures have been suggested, the risk rating has been assigned assuming mitigation measures are undertaken.
- 5.1.3. Potential pollution scenarios that may occur during piling operations on contaminated sites are listed below (PS1-PS6). An additional scenario beyond that specified in the guidance (impeding groundwater flow) has been included due to the use of retaining sheet-pile walls:
- PS1 - Creation of preferential pathways through a low permeability layer (an aquitard) to allow potential contamination of an aquifer;
 - PS2 - Creation of preferential pathways through a low permeability surface layer, allowing migration of landfill gas, soil gas or contaminant vapours to the surface;
 - PS3 - Direct contact of site workers and others with contaminated soil arisings that have been brought to the surface;
 - PS4 - Direct contact of the piles or engineered structures with contaminated soil or leachate causing degradation of materials;
 - PS5 - The pushing of contaminants down into an aquifer during pile driving;
 - PS6 - Contamination of groundwater and subsequently surface waters by wet concrete, cement paste, grout, bentonite slurry or polymer slurry; and
 - PS7 - Impeding groundwater flow resulting in groundwater mounding.
- 5.1.4. For piling works, risks to controlled waters are likely to be greater when:
- contaminants are present on the site and ground works could allow them to migrate;
 - piling would breach a low permeability layer or connect two previously discrete aquifers;
 - the site overlies a principal or secondary A aquifer;
 - the site is located within a Source Protection Zone;
 - the groundwater table is shallow or likely to be intersected by piles;
 - the geological strata are fractured or fissured; and

- works are close to a surface water body and run-off from arisings could pollute those waters.

- 5.1.5. The following sections provide an assessment of the potential risks associated with the proposed piling method of sheet piles against the proposed piling design. As part of this assessment, it has been assumed that mitigation measures during piling, good working practices and adherence to design guidance will be incorporated in the piling design and construction process.
- 5.1.6. Based on the outline proposed piling approach, the likelihood and magnitude of risk associated with each of the above pollution scenarios has been assessed.
- 5.1.7. The pollution scenarios presented in Section 5 have been assessed on the basis of using a displacement piling method for bridges and gantries to a maximum depth of 25 m and a driven method for retaining walls to a maximum depth of 12 m.

5.2. Piling Scenario Risk Assessment

5.2.1. The site specific considerations, overall risk and possible mitigation measures for each of the pollution scenarios are outlined in Table 5-1 and for retaining walls, and Table 5-2 for gantries and bridges.

Table 5-1 - Summary of pollution scenarios for sheet-pile retaining walls

Pollution Scenario	Piling Method	Pollution Scenario Risk	Comment	Mitigation Measures
No. 1 Creation of preferential pathway through aquitard to allow potential contamination of an aquifer	Sheet Piles (retaining walls)	Very Low	<ul style="list-style-type: none"> The logged lithologies of the superficial and bedrock deposits across the scheme into which the sheet-pile retaining walls will penetrate are relatively permeable and are not considered aquitards. The London Clay aquitard present throughout the Scheme is deeper than the maximum proposed depths of the retaining wall sheet piles. Therefore, the piling will not create preferential pathways through the London Clay aquitard. 	No specific mitigation required
No. 2 Creation of preferential pathway through low permeability surface layer	Sheet Piles (retaining walls)	Very Low	<ul style="list-style-type: none"> Whilst the piling activities may alter the existing pathways, there are no significant low permeability surface layers in the locations of the proposed retaining walls. Therefore, the risk of creation of preferential pathways through low permeability surface layers is very low. 	No specific mitigation required
No. 3 Direct contact of site workers with contaminated arisings	Sheet Piles (retaining walls)	Very Low	<ul style="list-style-type: none"> The driven piling method used to install sheet piles will cause little to no arisings. 	<p>No site-specific mitigation required.</p> <p>Contractors to be made aware of potential for contamination to be present in Made Ground (generic precautionary approach).</p>
No. 4 Direct contact of the piles with contaminated soil or leachate	Sheet Piles (retaining walls)	Very Low	<ul style="list-style-type: none"> The material used in the piling works should meet all requirements as stated in the GIR (HE551522-ATK-GEN-XX-RP-CE-000001) and Ground Design Report (HE551522-BBA-HGT-WHL_AL_SCHME-PC-CE-000001). 	<p>No site-specific mitigation required.</p> <p>Contractors to be made aware of any potentially aggressive ground conditions or groundwater and specify sheet piles accordingly (sacrificial thickness/corrosion-</p>

Pollution Scenario	Piling Method	Pollution Scenario Risk	Comment	Mitigation Measures
			<ul style="list-style-type: none"> Corrosion rates of steel sheet piles depends on a number of factors, including whether the pile is in contact with soil, air, fresh water or saline water, and if the soil is aggressive. 	resistant coating) (generic precautionary approach).
No. 5 Pushing solid contamination down into an aquifer	Sheet Piles (retaining walls)	Low	<ul style="list-style-type: none"> The proposed piling technique has a small cross-sectional area and will therefore result in limited pushing downwards of material. The proposed locations of the retaining walls are not near any identified sources (Appendix B) or soil GAC exceedances outlined within the GIR and GIR Addendum (HE551522-ATK-GEN-XX-RP-CE-000002). 	No site-specific mitigation required.
No. 6 Contamination of groundwater by wet concrete or grout	Sheet Piles (retaining walls)	N/A	<ul style="list-style-type: none"> No wet concrete or grout will be used with the driven piling method. 	No site-specific mitigation required.
No. 7 Impeding groundwater flow resulting in groundwater embankment	Sheet Piles (retaining walls)	Very Low	<ul style="list-style-type: none"> The potential for groundwater mounding exists where the groundwater flow direction is perpendicular to sheet piles that extend through an aquifer and into an aquitard. No sheet piles are expected to extend into the London Clay aquitard and the proportion of the aquifer into which the sheet piles are expected to extend is minimal, so the risk of creating an impediment to groundwater flow is considered very low. 	No site-specific mitigation required.

Table 5-2 - Summary of pollution scenarios for CFA piles for gantries and bridges

Pollution Scenario	Piling Method	Pollution Scenario Risk	Comment	Mitigation Measures
No. 1 Creation of preferential pathway through aquitard to allow potential contamination of an aquifer	CFA (gantries and bridges)	Very Low	<ul style="list-style-type: none"> Piles installed to the maximum proposed depth (25 m) will penetrate less than 3 metres into the top of the London Clay aquitard at Clearmont Overbridge and the following gantry locations: M25_GN01_EB, M25_GN01_WB, M25_GN05_EB, M25_GN05_WB, M25_GN06_WB, M25_GN07_EB, M25_GN07_WB. However, the London Clay is sufficiently thick enough (>14.3 m) that no piles will penetrate through the aquitard 	No specific mitigation required

Pollution Scenario	Piling Method	Pollution Scenario Risk	Comment	Mitigation Measures
			<p>and no preferential pathway will be created to sensitive aquifers at depth.</p> <ul style="list-style-type: none"> The logged lithologies of the superficial and bedrock deposits above the London Clay across the scheme into which the CFA piles will penetrate are relatively permeable and are not considered aquitards. 	
No. 2 Creation of preferential pathway through low permeability surface layer	CFA (gantries and bridges)	Very Low	<ul style="list-style-type: none"> The laterally discontinuous unsaturated superficial Swinley Clay Member is found overlying the Bagshot Formation for approximately 500 m along the A3 north of Junction 10. Piles will penetrate the Swinley Clay Member at Redhill Overbridge and the following gantry locations: A3_GN04_NB, A3_GN05_SB, A3_GN05_NB, A3_GN06_SB and A3_GN06_SB. No potential sources of contamination or soil sample exceedances of the GAC [7] have been identified near the proposed piling locations that will penetrate the Swinley Clay Member. 	The proposed CFA piling method emplaces grout in the boreholes following auguring which is considered to reduce the likelihood of creating preferential pathways.
No. 3 Direct contact of site workers with contaminated arisings	CFA (gantries and bridges)	Low	<ul style="list-style-type: none"> The proposed piling technique will bring arisings to the surface. Potential sources of contamination are present at Wisley Lane Overbridge, the New J10 Bridges, and the following gantry locations: A3_GN12_SB, A3_GN03_NB, and A3_GN01_NB. 	Appropriate method statements and risk assessments will outline the procedure for the identification of unexpected contamination. This procedure will align with Requirement 13 of the Development consent order. Contractors should implement appropriate management of arisings, including segregation of Made Ground from natural ground, and prevention of run-off.
No. 4 Direct contact of the piles with contaminated soil or leachate	CFA (gantries and bridges)	Low	<ul style="list-style-type: none"> Material used in piling should meet all requirements as stated in the GIR and Ground Design Report. 	Contractors to be made aware of any potentially aggressive ground conditions or groundwater. Concrete specified accordingly (generic precautionary approach).

Pollution Scenario	Piling Method	Pollution Scenario Risk	Comment	Mitigation Measures
No. 5 Pushing solid contamination down into an aquifer	CFA (gantries and bridges)	Very Low	<ul style="list-style-type: none"> Proposed piling technique will bring arisings to the surface and is unlikely to push material further down into the aquifer. 	Ensure no under-rotation of augers.
No. 6 Contamination of groundwater by wet concrete or grout	CFA (gantries and bridges)	Low	<ul style="list-style-type: none"> Non-displacement (bored) piles require either (or a combination of) concrete, cement paste or grout to be introduced into the ground. This may result in the loss of wet concrete, cement paste or grout in fast-flowing groundwater associated with fractured/jointed rocks or permeable gravel formations. If retardant additives are used, pile materials could take several hours to set. Pile depth is expected to reach into the Bagshot Formation, so potential for fissure interception is considered low. The granular nature of the upper geological layers within the aquifer is considered to reduce the risk that large volumes of grout will be lost. 	Measure volumes of concrete / grout used and plan for loss if identified (generic precautionary approach).
No. 7 Impeding groundwater flow resulting in groundwater embankment	CFA (gantries and bridges)	Low	<ul style="list-style-type: none"> No impact to groundwater flow due to single pile locations for CFA piles. 	No site-specific mitigation required.

6. Summary

- 6.1.1. A piling risk assessment has been undertaken for the M25 Junction 10 / A3 Wisley Interchange Improvements Scheme in order to support piling works. Piling works are expected to be undertaken throughout the Scheme and will be associated with the construction of retaining walls, bridges and gantries.
- 6.1.2. The assessment has reviewed the potential risk from the use of the proposed piling methodology as detailed in Section 5 in seven different pollution scenarios. The risks associated with the assessed Piling Scenario activities have been identified as either Low or Very Low, subject to the specific mitigation measures set out in Table 5-1 and Table 5-2.
- 6.1.3. The piling options discussed above are also subject to appropriate workmanship and QA/QC measures being adopted. The piling works should be subject to appropriate oversight and carried out in line with a suitable method statement.

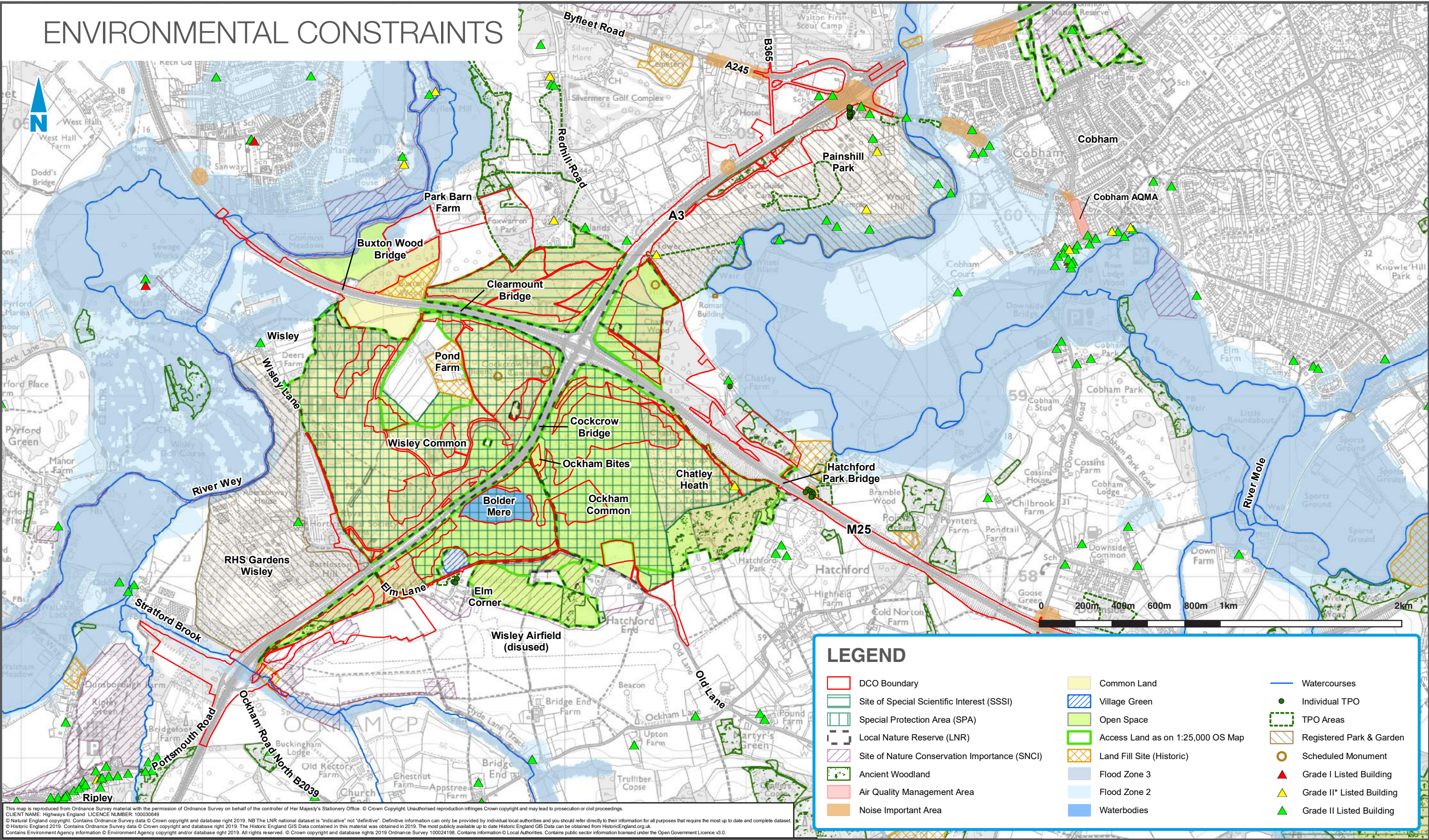
7. References

- [1] Highways England, "M25 junction 10/A3 Wisley interchange - TR010030 - 7.3 Register of environmental actions and commitments. HE551522-ATK-EAC-RP-LM-000004," 2021.
- [2] Highways England, "M25 junction 10/A3 Interchange - TR010030 - Environment Statement Chapter 8: Road Drainage and the water environment," 2019.
- [3] Highways England, "M25 Junction 10/A3 Wisley Interchange - TR010030 - Environment Statement Chapter 10: Geology and soils," 2020.
- [4] Highways England, "M25 junction 10/A3 Wisley interchange - TR010030 - 3.1 Draft Development Consent Order," 2019.
- [5] Environment Agency, "Piling and Penetrative Ground Improvement Method on Land Affected by Contamination: Guidance on Pollution Prevention. National Groundwater and Contaminated Land Centre Report NC/99/73," 2001.
- [6] Highways England, "M25 junction 10/A3 Wisley interchange - TR010030 - Ground Investigation Report. HE551522-ATK-GEN-XX-RP-CE-000001," Highways England, 2020.
- [7] Highways England, "M25 junction 10/A3 Wisley interchange improvement - TR010030 - Ground Investigation Report Addendum, HE551522-ATK-GEN-XX-RP-CE-000002," 2021.
- [8] Highways England, "M25 junction 10/A3 Wisley interchange - TR010030 - 2.9 Engineering drawings and sections," 2020.
- [9] CIRIA, "C552 Contaminated Land Risk Assessment - A Guide to Good Practice. IBN 0 86017 552 9," 2001.

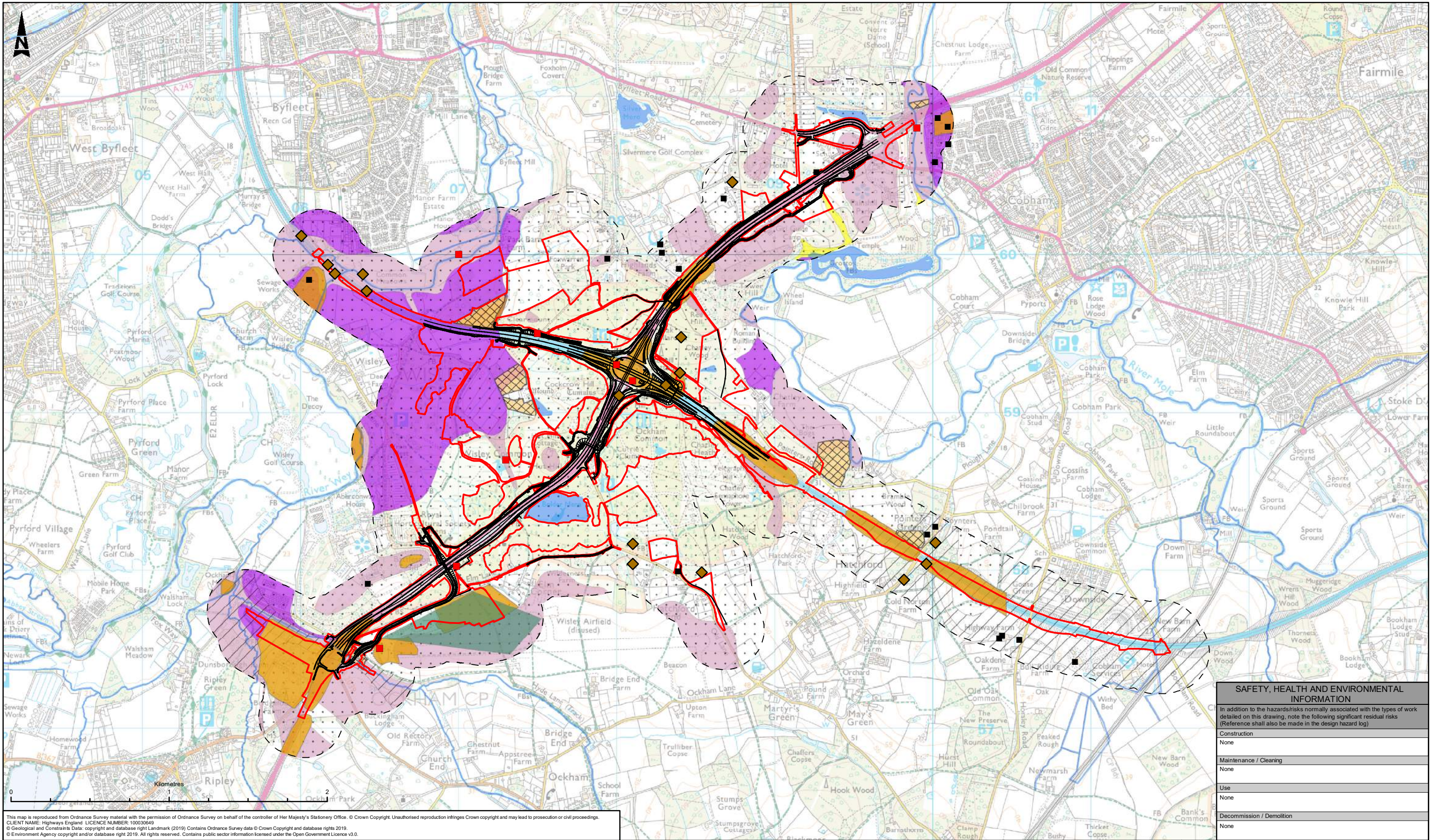
Appendices



Appendix A. Environmental Constraints



Appendix B. Potential Sources of Contamination



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LEGEND

DCO Boundary

250m Study Area

Proposed Engineering Design

Surface Water Courses

Surface Water Bodies

Artificial Ground

Potentially Infilled Land

Other Potentially Contaminative Activities and Incidents

Pollution Incidents

Contaminated Land Use

Landfill

Approximate Location of Wisley Airfield

Bedrock Aquifer

Secondary Aquifer - A

Unproductive Strata

Superficial Aquifer

Principal Aquifer

Secondary Aquifer - A

Secondary Aquifer - Undifferentiated

DESCRIPTION

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ATKINS

Member of the SNC Lavalin Group

Epsom Gateway

Ashley Avenue

Epsom

Surrey

KT18 5AL

Tel: +44 (0) 1372 726140

Fax: +44 (0) 1372 740055

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Client

highways

england

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction

None

Maintenance / Cleaning

None

Use

None

Decommission / Demolition

None

Project Title

PILING RISK ASSESSMENT

M25 Junction 10

Drawing Title

APPENDED FIGURE 2:

GEOLOGY AND SOILS, SOURCES OF

POTENTIAL LAND CONTAMINATION

Drawing Number

Project

Originator

Volume

HE551522 - ATK - EGT

XX - GS - GI - 000001

Original Size

A3

Scale

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Project Ref. No.

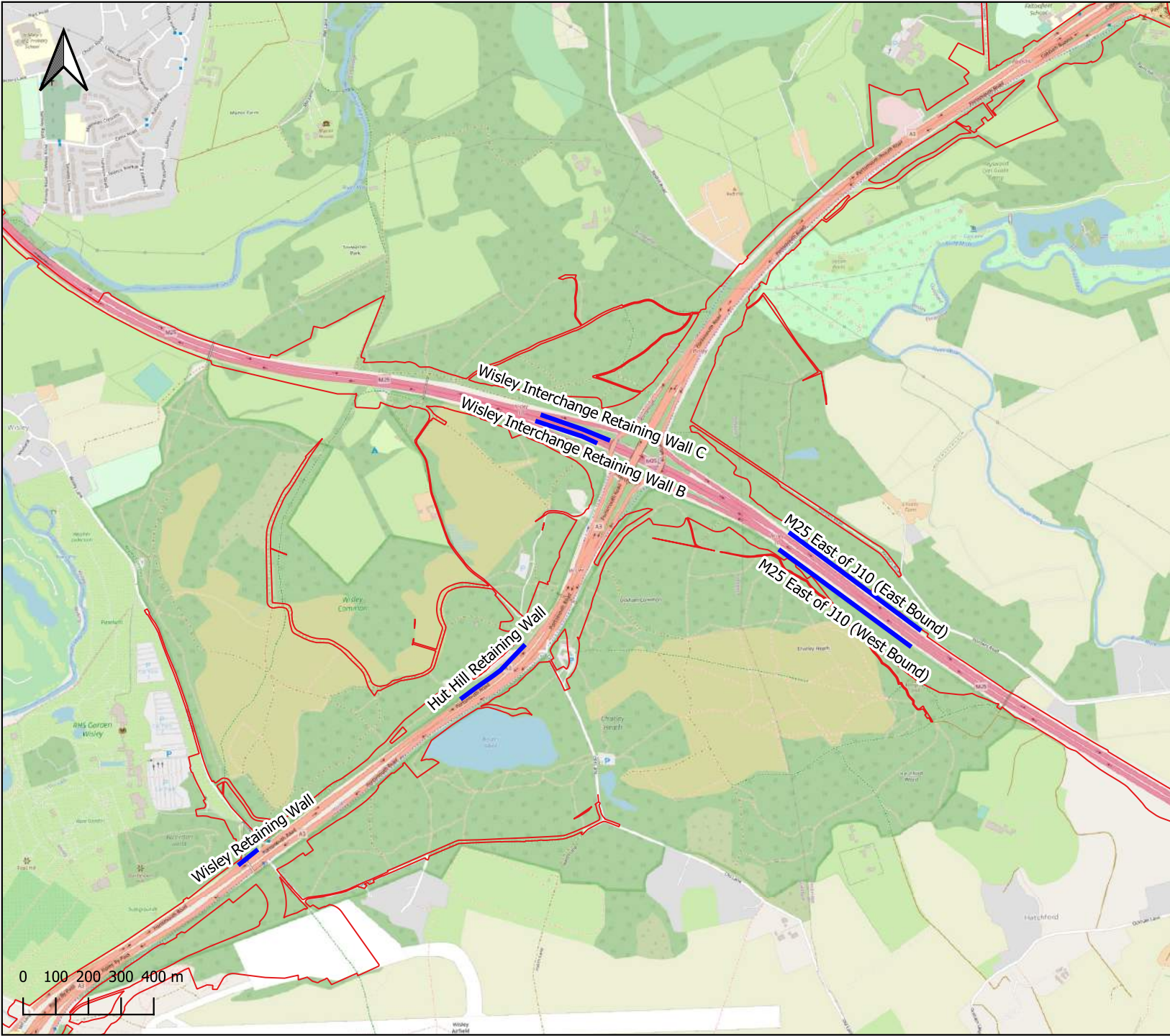
Sheet

1 of 1

Rev.

C02

Appendix C. Retaining Wall Piling Location Plan



Notes

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LEGEND

Scheme Boundary

Retaining Walls

ATKINS

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Nova North, London

Client

Highways England

Project Title

M25 Junction 10 Ground Investigation

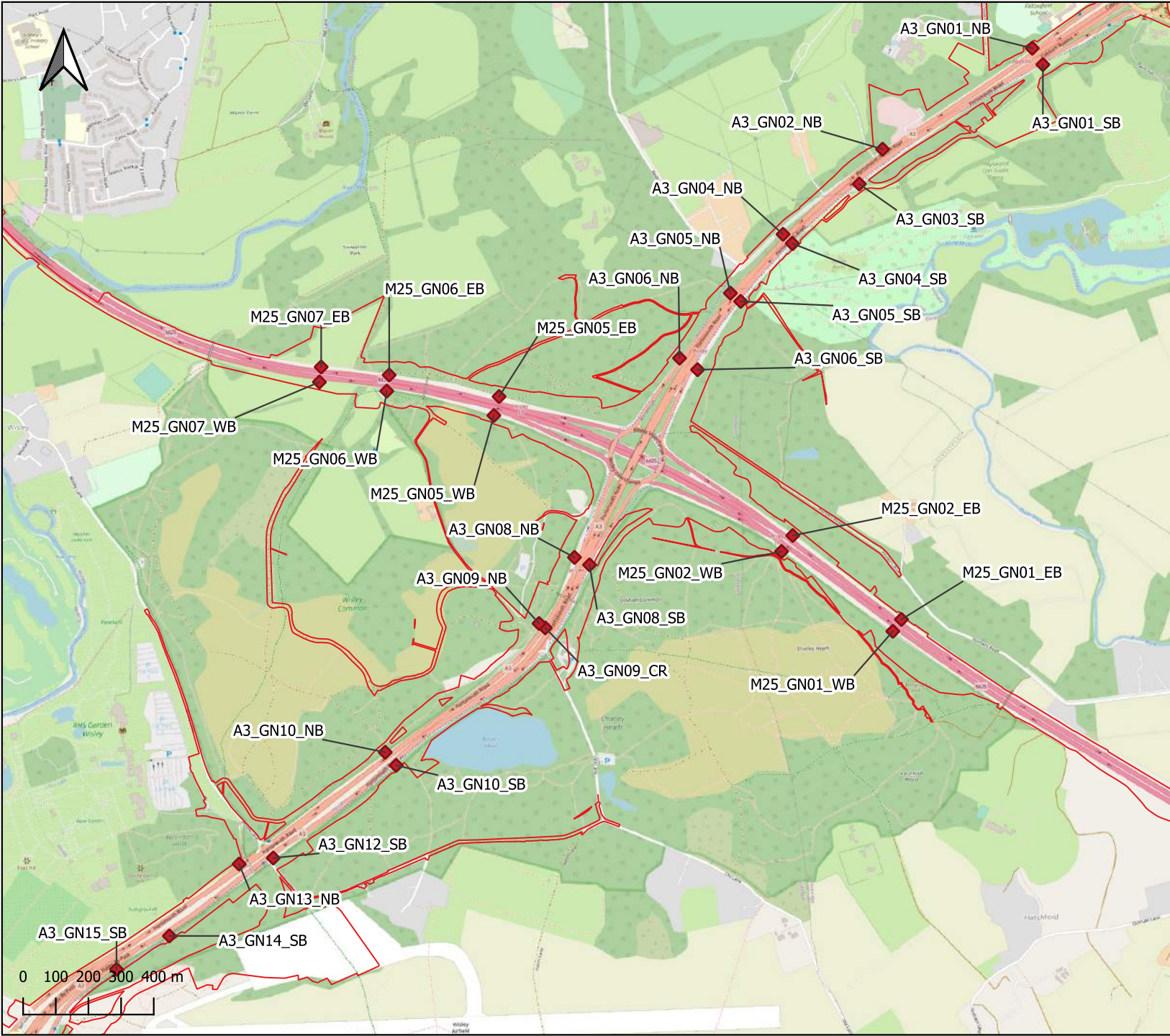
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Retaining Wall Location Plan

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Drawing Number	Revision
v0.1	01

Appendix D. Gantry Piling Location Plan



Notes

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LEGEND

Scheme Boundaty

Gantry Pile Location

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Nova North, London

Client

Highways England

Project Title

M25 Junction 10 Ground Investigation

Drawing Title

Gantry Location Plan

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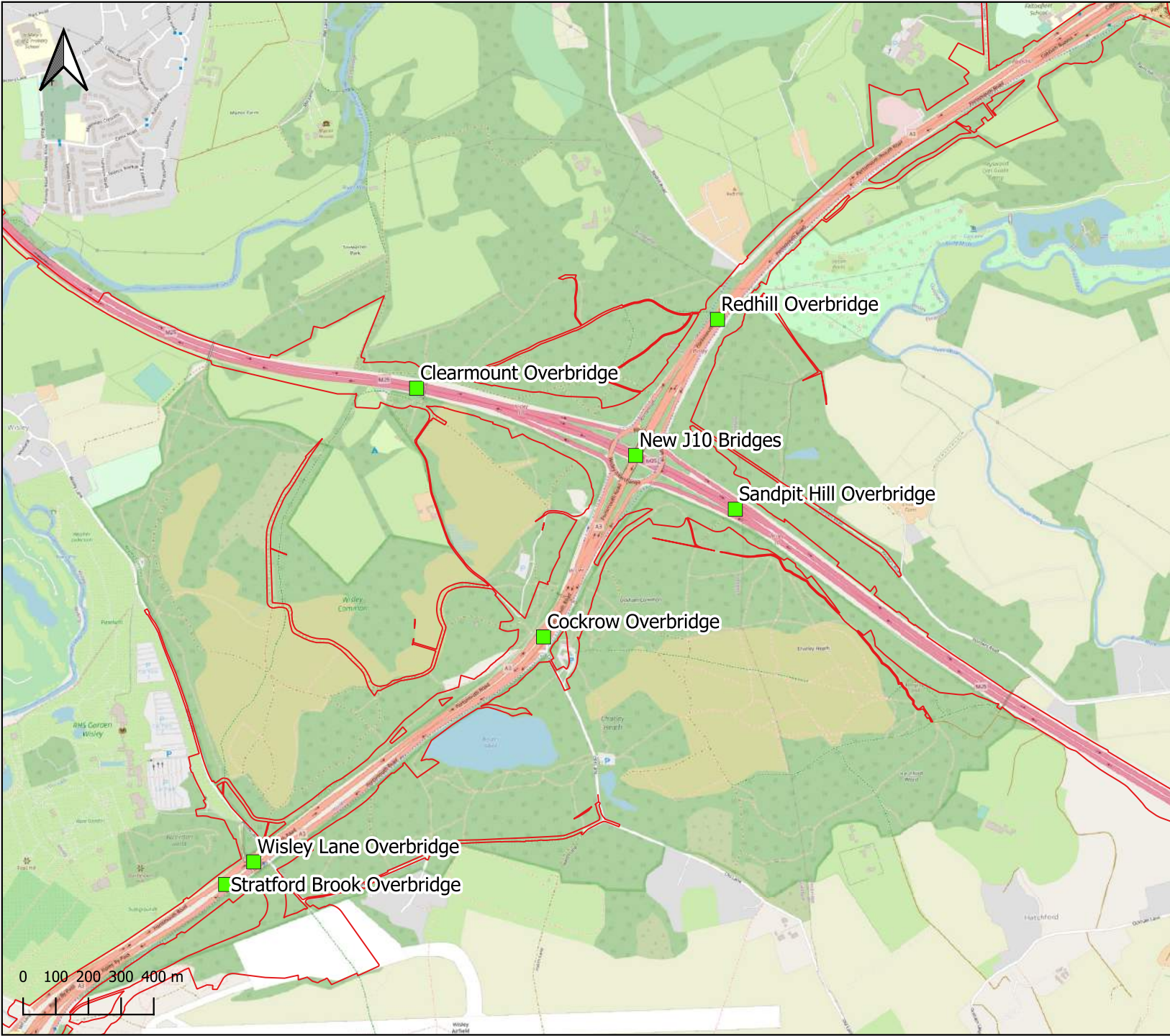
Drawing Number

v0.1

Revision

01

Appendix E. Bridge Piling Location Plan



Notes

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LEGEND

Scheme Boundary

Bridge Pile Location

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Nova North, London

Client

Highways England

Project Title

M25 Junction 10 Ground Investigation

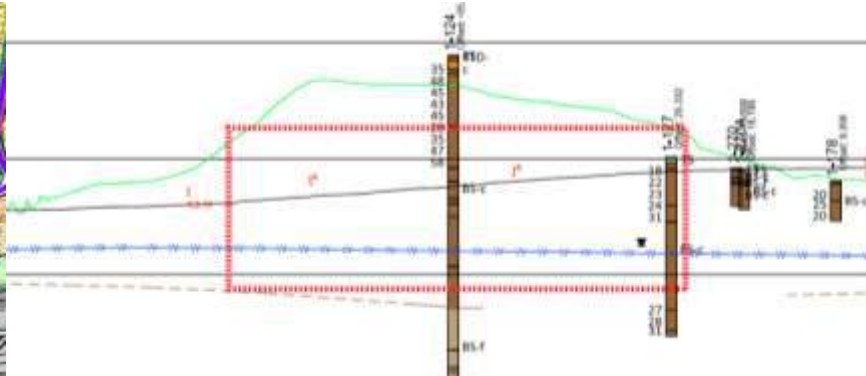
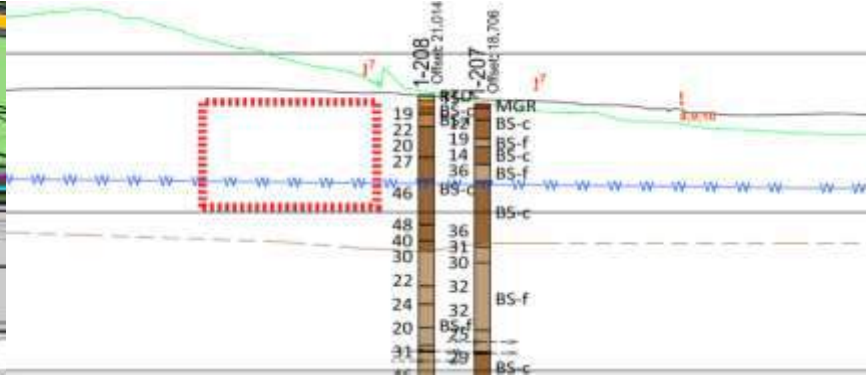
Drawing Title

Gantry Location Plan

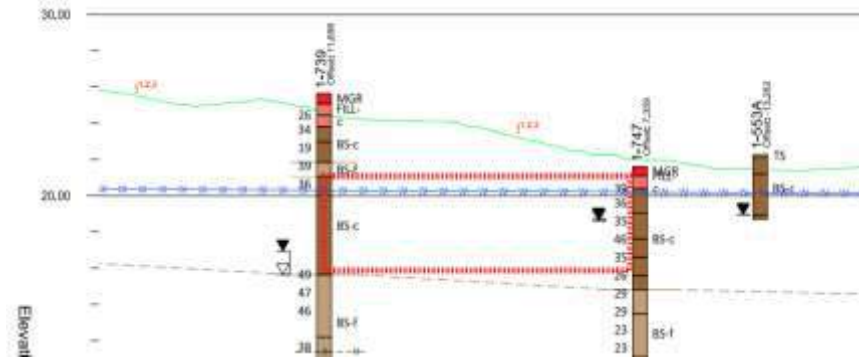
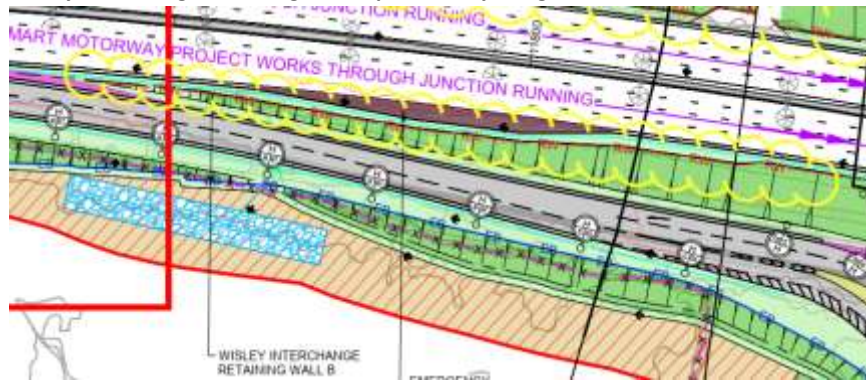
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Drawing Number	Revision
v0.1	01

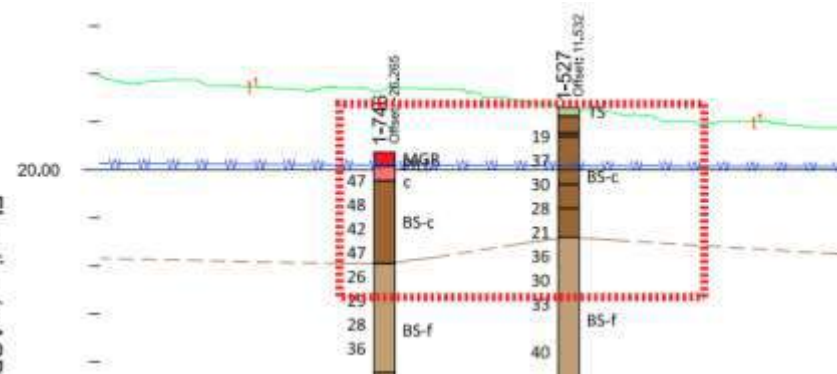
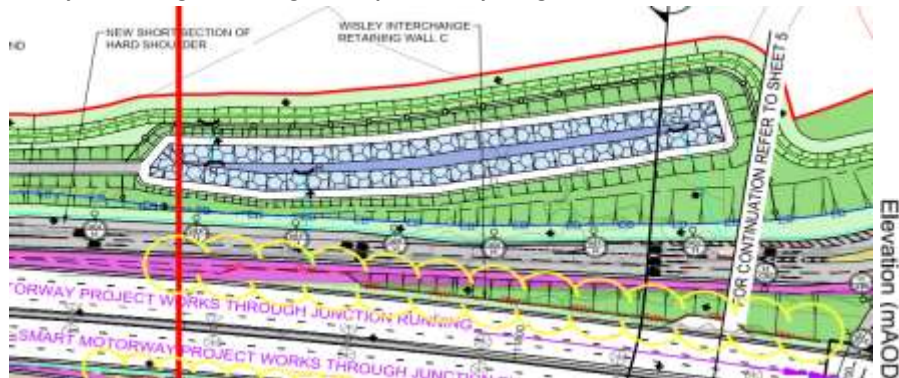
Appendix F. Preliminary Retaining Wall Design

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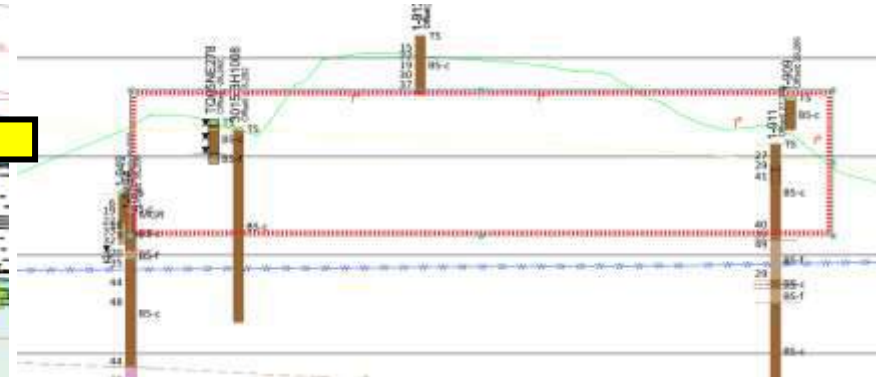
Wisley Interchange Retaining Wall B preliminary design



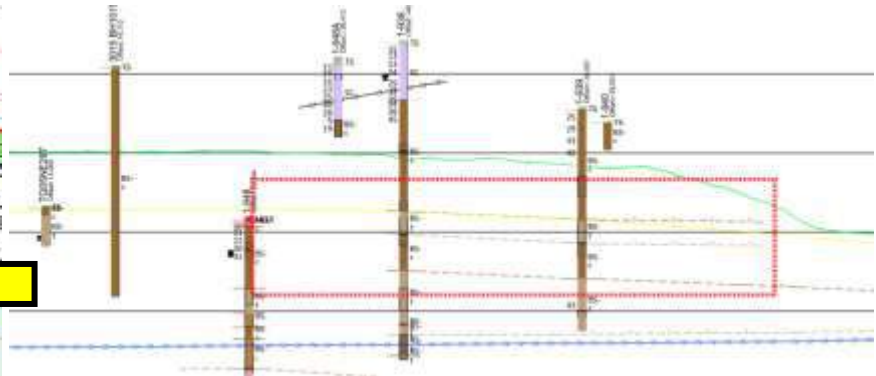
Wisley Interchange Retaining Wall C preliminary design



M25 East of Junction (East Bound) retaining wall preliminary design



M25 East of Junction (West Bound) retaining wall preliminary design



Howard Williams

BBA Project Director

Atkins Offices
Woodcote Grove
Ashley Road
Epsom
Surrey
KT18 5BW

Howard.Williams@balfourbeatty.com