LTA2 GI Employment Access Road (EAR)

Interpretative Report

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This document has been prepared and checked in accordance with Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015 and BS EN ISO 45001:2018)

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Comments

Comments

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Objectives

Waterman Infrastructure and Environment Ltd was instructed by Graven Hill Village Development Company Limited to undertake a Ground Investigation Interpretative report for the proposed development of the Employment Access Road.

Site Setting

Current Use The Site currently comprises of the southern extent of Anniversary Avenue and an access road leading to the "D" Sector of the former MOD Bicester Site.

Environmental Assessment

When screened against assessment criteria for a commercial/non-residential end use, no exceedances of heavy metals or TPH fractions were recorded. Exceedances of individual PAH's were recorded at three locations within asphalt and Made Ground and are thought to represent the presence of coal tars.

No asbestos fibres were recorded in any of the samples screened.

Due to the proposed end use, the recorded chemical concentrations are not considered to represent a risk human health (end users) however the risk to construction workers must be considered.

Widespread contamination has not been recorded at the Site which would represent a significant risk to construction workers. Locations recording elevated levels of PAHs are within the current Anniversary Avenue roadway which is proposed to be replaced as part of the redevelopment of the Site. Construction workers must adhere to good practices hygiene during works. Any soils intended for re-use on Site or disposal must be assessed for their suitability.

Due to the elevated carbon dioxide concentrations recorded within BH703, construction workers entering excavations shall wear respiratory protective equipment (RPE) to mitigate the risk posed by oxygen depletion as the result of elevated carbon dioxide.

As part of protection against the potential risk posed by contamination in near surface soils, elevated carbon dioxide and potential asbestos, the mandatory use of PPE and RPE when operating within areas of known contamination and when within excavations should be adhered to at all times and provisions should be made for appropriate Site hygiene and welfare facilities and dedicated food preparation and eating areas.

Given the nature of the current site use, and that asbestos has been encountered in other areas of the Site, all personnel must have asbestos awareness training.

The recorded concentrations are not considered to represent a risk to controlled waters receptors.

Geotechnical Assessment

The Site is underlain by a thin layer of bituminous surfacing, Roadstone, Made Ground and topsoil.

The Made Ground and road construction are underlain by firm and stiff Oxford Clays.

The existing Anniversary Avenue and unnamed access roads consist of three different construction make ups:

Typically 130mm to 250mm of bituminous surface over 420mm to 620mm of roadstone is recorded.

Unnamed access roads: Typically 80mm to 110mm of bituminous surface over 390mm to 820mm of roadstone.

Hardstanding along proposed roadcourse: Typically 300mm of concrete over 100mm of granular Made Ground, 100mm of concrete and 300mm of cohesive Made Ground.

In all locations Bituminous surfacing and Made ground is underlain by firm to stiff clay.

Oxford Clay has been shown to have a high plasticity and medium to High volume change potential. A Plasticity Index of 50% should be adopted for the Oxford Clay at this location.

Whilst the values stated above are indicative of the data, particular care should be given when designing roadways in this area of the Site. Due to historic loading of the clays underlying this area of the Site, differential settlement is likely, particularly when comparing areas of open ground and those previously occupied by buildings, such as building D5.

Buried concrete should be designed in accordance with:

Concrete in contact with the existing roadstone: DS3 AC2

Concrete in contact with Oxford Clay: DS3 AC3s

The results of compaction testing undertaken on samples of Oxford Clay indicate that the natural moisture content is significantly in excess of the optimum moisture content and hence the near surface materials would not be suitable in their current form for use as an earthworks material unless the materials are allowed to dry or are treated to reduce the moisture content (i.e. lime stabilised).

In-situ CBR values of the firm clays immediately below the existing roadstone recorded values of between 6.7 and 9.5% with the underlying strata giving values of between 2.6 and 70%. In view of the high plasticity of the clays and their susceptibility to rapid softening, it is recommended that a design CBR of 3% be adopted for firm clays and a value of 5% for stiff clays.

During construction, the in-situ CBR value must be checked against the Design CBR value, to confirm design requirements are being met.

Groundwater levels were recorded and monitoring undertaken within BH703 along the line of the proposed Employment Access Road (EAR) and adjacent to the Anniversary Avenue and unnamed access roads.

Groundwater depths and elevations varied greatly across the site.

Groundwater level was recorded circa 3.6m bgl in BH703 adjacent to Building D1.

Seepage was recorded between 0.4m and 0.5m bgl in RC703 and TP707.

Seepage was recorded at 2.00m bgl in TP801, 2.70m bgl in TP704 and at 3.00m bgl in TP803.

Fast inflow was recorded at 0.28m bgl in RC709 and at 0.50m bgl in TP830.

No other groundwater strikes are recorded.

Based on observation made during fieldwork, shallow excavations (<1.2m) are likely to remain stable in the short term.

Should water ingress be encountered in excavations, it is anticipated that this could be controlled by simple sump pumping techniques.

Excavations left exposed for some time with shallow groundwater may need forming with safe batters and dewatering.

Trenches should be excavated in accordance with CIRIA Report 97 ‘Trenching Practice’.

In line with BS6031, all excavations should be examined daily by a competent person to ensure that they remain safe. Where the sides cannot be sloped back to a safe angle, as approved by a competent and experienced person, their continued stability should not be taken for granted. Vertical or steep faces should be provided with support unless instructed otherwise by a competent person.

1. Introduction

1.1 Objectives and Brief

Waterman Infrastructure & Environment Limited (hereby referred to as 'Waterman') was instructed by Graven Hill Village Development Company Limited (GHVDC) to undertake a Ground Investigation and Interpretative Report for the design of the proposed Employment Access Road (EAR) at the Graven Hill development site.

The main objectives of the report are to:

- Investigate the pavement construction of the current Anniversary Avenue and provide design parameters for the proposed Employment Access Road;
- Derive representative geotechnical parameters in accordance with Eurocode 7 and characterize the ground for the purposes of geotechnical design;
- Provide an investigation of ground contamination as defined by BS10175;
- Assess the suitability of potential materials arising in earthworks activities for re-use on site or disposal.

The contamination assessment has been undertaken in general accordance with the Land Contamination Risk Assessment (LCRM) 2020 (Environment Agency), and forms a decision record in relation to the assessment of the site. The report provides a conceptual model based on the findings of the ground investigation, an evaluation of potential risks and recommendations relating to any necessary remediation.

The assessment was undertaken in accordance with the scope agreed between Waterman and GHVDC and with Waterman's Terms of Appointment. The benefit of this report is made to GHVDC.

1.2 The Proposed Development

The proposed layout is included as General Arrangement drawings: *WIE11386-EAR-90-105-GA-A06 Sheets 1-6,* in Appendix A. The proposed Employment Access Road includes a roundabout at is southern extent, pedestrian footpaths, cycleways and soft landscaping. The proposed layout drawings show the proposed alignment of the EAR which will be part completely new construction and part upgrade and widening of the existing Anniversary Avenue.

Along the section of the route which follows the existing Anniversary Avenue, and passes over the former D6 building footprint, there are some areas of cut and fill, but generally the finished levels are very similar to existing levels. Where the route passes the former footprint of Building D9, it follows the line of a former railway line which was in a cutting. This area is to be filled with up to 2.50m of filling required in places.

A large stockpile of natural clay from the Phase 1 development is currently located on the route of the road, adjacent the proposed A41 roundabout and will need to be removed.

1.3 Limitations

The information contained in this report is based on the findings of a ground investigation carried out under the supervision of Waterman, including observations made on site, exploratory hole records, laboratory test results, groundwater monitoring and ground gas monitoring. The investigation covered the wider Land Transfer Area 2 and only information relative to the EAR is included in this report.

The ground conditions reported relate only to the point of excavation and do not necessarily guarantee a continuation of the ground conditions throughout the non-inspected area of the site. Whilst such exploratory holes would usually provide a reasonable indication as to the general ground conditions, these cannot be determined with complete certainty.

Waterman has endeavoured to assess all information provided to them during this investigation, but makes no guarantees or warranties as to the accuracy or completeness of this information.

The scope of this site investigation includes an assessment of the presence of asbestos containing materials in the ground at the site but not within buildings or structures or below ground structures (basements, buried service ducts and the like).

The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

2. Previous Works

As part of the infrastructure of the former MOD site, a site wide above ground heating pipe system was present which we understand had previously included asbestos containing gaskets. No records of the removal of the pipework are available and hence in January 2021, a soil sampling operation was undertaken on behalf of the demolition contractor, Armac, along the line of the former pipe to assess any potential asbestos contamination of the surface layer as a result of the pipework removal works.

The pipeline previously followed the line of Anniversary Avenue, between the road and the boundary fence. Thirty-two locations in the vicinity of the EAR were sampled and screened for asbestos fibres; four samples recorded a positive screen for asbestos fibres. A copy of the Soil Samples Location drawing (ref: *ARMAC's_ Sampling Locations_009 Rev A)* is presented in Appendix A.

The topsoil within the area of the 4 locations are to be subject to a site strip and the materials removed from site.

3. Methodology

The intrusive investigation was undertaken in general accordance with Eurocode 7, the Code of Practice for Ground Investigation BS 5930 (2015+A1:2020) and the Code of Practice for the Investigation of Potentially Contaminated Sites BS 10175 (2011+A2:2017).

The objectives of the investigation were to characterise the ground conditions, any hazard sources, pathways and receptors and to reduce uncertainties associated with the proposed redevelopment.

3.1 Design of Investigation

The location of exploratory holes and in particular, in-situ geotechnical testing, was chosen so as to assess the quality of ground for the proposed highway and roundabout construction works.

Soil samples were carefully selected in order to characterise the ground conditions and to target, as far as possible, any potential areas of contamination.

3.2 Quality Control

A Waterman Geo-Environmental Engineer monitored the performance, quality of work and health and safety compliance of the specialist contractor, Geotechnics Limited. Appropriate chemical and geotechnical samples were obtained for subsequent testing at a UKAS accredited laboratory.

All contractors, including laboratories, used during this project have been approved by Waterman as a part of in-house Integrated Management System (BS ISO 9001, BS ISO 14001) procedure. This requires all third parties to demonstrate competence and a high standard of work during a regular audit scheme.

3.3 Health and Safety

All work carried out on site was in accordance with Geotechnics Ltd's Health & Safety Plan.

4. Fieldwork

Fieldwork was carried out as part of a larger investigation at the Graven Hill Site. For the purpose of this report, only exploratory holes relevant to the proposed roadway, cycleways, pedestrian footpaths and roundabout are considered.

The locations of the exploratory holes excavated, as per Geotechnics Factual report (ref: PC207899 Graven Hill, Bicester, Land Transfer Area 2 (LTA2) Factual Report) are shown on Drawings: *WIE11386-139-87-100-EAR GI Locations Sheet 1 – Sheet 7*, presented in Appendix A.

4.1 Ground Investigation

The Site was investigated as part of a larger Ground Investigation programme at Graven Hill. Any description hereafter, unless explicitly specified, refers to the section of the Geotechnics Ltd Ground Investigation conducted within the Employment Access Road Site Boundary, outlined in the drawing: WIE11386-EAR-90-001-Red Line Boundary-A05 included in Appendix A, and its immediate surroundings.

The works comprised the following:

- 17no. Trial Pits (TP329, TP425, TP430, TP702-TP707, TP801-TP803, TP825, TP829, TP830) were excavated to depths of between 0.50m and 4.50m bgl using a wheel mechanical excavator. Upon completion, excavations were backfilled as far as possible with arisings.
- 11no. Road Cores (RC701 to RC710, RC801) were advanced through the existing Anniversary Avenue road and one location (RC801) through hardstanding near building D5. The underlying materials were excavated by hand to depths of between 0.55m and 1.20m bgl. Dynamic Cone Penetrometer tests were carried out at the base of each hole, extending to depths of up to 2.08m bgl, to allow the CBR value of the underlying soils to be assessed.
- 8no. Cable Percussive Boreholes (BH319, BH701-BH705, BH801, BH803, BH807) were advanced to depths of between 6.10 and 6.60m bgl with associated in-situ testing and sampling.
- 1no. standpipe installed in cable percussion borehole (BH703) and subsequent water level monitoring.
- 1no. concrete core with hand dug trial hole (CC501).
- 14no. sediment samples from ditch courses (SSC506-SSC508, SSC701-SSC712, SSC810).

4.2 Soil Sampling

During excavation, samples for chemical analysis were placed on plastic sheeting to prevent cross-contamination of soil. Representative soil samples were obtained from the exposed strata and sealed in one litre plastic tubs with airtight lids, phials and glass jars containing preservatives, as appropriate. The soil samples taken were subject to screening with a photo ionisation detector (PID).

Disturbed and undisturbed samples were taken at regular intervals and retained for geotechnical laboratory testing.

5. Results

Detailed logs of the strata encountered, together with records of the samples taken during both trial pitting and borehole installation along with PID readings, are provided in Appendix B. A summary of the geological strata encountered is presented below.

5.1 Geological Strata

The strata encountered in the investigation were generally consistent with the anticipated geology although in some locations, variances in Made Ground and buried anthropogenic horizons were encountered that were not anticipated. A summary of the geological strata encountered is shown in Table 1.

Table 1: Geological strata encountered

Soil Type	Depth of Top of Stratum (mbgl)	Thickness (m)	Typical Description
Existing Anniversary Avenue and unnamed access roads			
Asphalt	0.00	0.08 to 0.25	Asphalt RC701 to RC710: 0.13m – 0.25m RC801: 0.08m BH702, BH704, BH705 and BH807: 0.10m - 0.20m
Concrete	0.00 and 0.30	0.10 – 0.30	Concrete Layer only recorded in TP707 at 0.00m to 0.3m bgl.
Made Ground 1 / Roadstone	0.08 to 0.25	0.09 – 0.47	Light brown very sandy clayey gravel with a low cobble content. Gravel is subangular fine to coarse limestone. Locally with a slight hydrocarbon odour.
Made Ground 2/ Sandy Gravel	0.13 to 0.60	0.09 to 0.40	Dark Grey to black slightly sandy gravel with a slight hydrocarbon odour. Gravel is angular fine to coarse asphalt, granite and slag. Odour recorded locally in RC703, RC704 and RC706.
Made Ground 3/ Lower Roadstone	0.23 to 0.60	0.15 to 0.40	Black mottled dark grey sandy clayey gravel with cobbles of much angular to subangular limestone. Gravel is subangular fine to coarse ash and limestone, fine to coarse quartzite, sandstone and concrete. Locally with a slight hydrocarbon odour in BH701, RC704.
Oxford Clay	0.60 to 0.90	>0.30 to >0.60	Firm brown mottled grey slightly sandy CLAY. Occasional pockets (up to 30mm in size) of light brown fine to medium sand.
Land along proposed route of EAR			
Made Ground 4/ Gravelly Clay	0.00	0.30	Firm dark brownish grey slightly sandy slightly gravelly clay with many rootlets. Gravel is angular to subangular fine to coarse brick, concrete and limestone.
Oxford Clay	0.30 to 2.20	0.60 to 2.70	Firm orangish brown mottled grey slightly sandy CLAY with occasional pockets (up to 120mm in size) of decomposed organic material. Stiff from 2.20m bgl.

Soil Type	Depth of Top of Stratum (mbgl)	Thickness (m)	Typical Description
Oxford Clay	2.70	3.90	Stiff grey slightly sandy CLAY with occasional gypsum crystals (up to 63mm in size) and occasional shell fragments (up to 20mm in size). BH803: Many gypsum crystals between 3.85 and 4.00m. Gypsum crystals absent below 5.00m

Hardstanding covers approximately 70% of the route of the proposed EAR. In the southwest and centre of the Site, Anniversary Avenue, unnamed access roads, buildings D9, D6, D5, D12, D11, D3, D1 and D8 and former MOD railway lines create hardstanding and anthropogenic ground cover. The remaining 30% is covered by managed open space.

5.2 Underground Structures and Obstructions

TP707 was terminated at a depth of 0.80m bgl due to close proximity to a live service.

No other underground structures or obstructions were encountered.

5.3 Potential Sources of Contamination

Hydrocarbon odours were noted within former roadstone in RC701, RC702, RC703, RC704, RC705 and RC706, although this is considered likely to be due to the overlying macadam layers. No other visual or olfactory evidence of contamination is noted.

5.4 Trench Stability

All trial holes were noted as being stable.

Based on observation made during the fieldwork, shallow excavations (<1.2m) are likely to remain stable in the short term.

Should water ingress be encountered in excavations, it is anticipated that this could be adequately controlled by simple sump pumping techniques.

Excavations left exposed for some time with shallow groundwater may need forming with safe batters and dewatering.

Trenches should be excavated in accordance with CIRIA Report 97 'Trenching Practice'.

In line with BS6031, all excavations should be examined daily by a competent person to ensure that they remain safe. Where the sides cannot be sloped back to a safe angle, as approved by a competent and experienced person, their continued stability should not be taken for granted. Vertical or steep faces should be provided with support unless instructed otherwise by a competent person.

5.5 Geotechnical and Chemical Analysis

The laboratory test results are presented in Appendices C and D.

5.6 Asbestos

No asbestos was encountered within Made Ground samples tested as part of the investigation.

The topsoil within the area of the 4 locations along the line of the former heating pipeline where asbestos was recorded are to be subject to a site strip and the materials removed from site.

5.7 Groundwater Levels

Groundwater levels were monitored in boreholes along the line of the proposed Employment Access Road (EAR) and adjacent to the Anniversary Avenue and unnamed access roads.

Groundwater depths and elevations varied greatly across the site and generally recorded:

- Groundwater level was recorded circa 3.6m bgl in BH703 adjacent to Building D1.
- A seepage was recorded between 0.4m and 0.5m bgl in RC703 and TP707.
- A seepage was recorded at 2.00m bgl in TP801, 2.70m bgl in TP704 and at 3.00m bgl in TP803.
- Fast inflow was recorded at 0.28m bgl in RC709 and at 0.50m bgl in TP830.

No other groundwater strikes are recorded.

5.8 Ground Gas Monitoring

The installation within BH703 was monitored on seven occasions between the 31st July and the 28th September 2020. Throughout this monitoring, no groundwater was recorded within the standpipe, which was installed to 1.88m bgl (67.92m AOD). Barometric pressure during monitoring visits varied between 998mbar and 1007mbar.

The results of monitoring are summarised below in Table 2.

Table 2: Ground gas monitoring summary

Monitoring Point / Date	Peak Gas Concentration (%)			Steady Gas Concentration (%)		
	CH_4	CO_2	O_2	CH_4	CO_2	O_2
BH703 / 31.07.20	<0.1	5.8	20.2	<0.1	5.8	14.3
BH703 / 05.08.20	<0.1	8.4	14.8	<0.1	8.4	12.4
BH703 / 12.08.20	<0.1	9.6	20.2	<0.1	9.6	12.5
BH703 / 20.08.20	<0.1	<0.1	21.1	<0.1	<0.1	20.7
BH703 / 03.09.20	<0.1	18.6	7.6	<0.1	6.1	7.0
BH703 / 15.09.20	<0.1	11.1	20.3	<0.1	11.1	6.3
BH703 / 28.09.20	<0.1	12.6	19.3	<0.1	12.6	7.0

A flow rate of <0.1l/hr was recorded across all monitoring visits

6. Geotechnical Testing

6.1 In-Situ Testing

Standard Penetration Tests (SPT's) were undertaken at regular intervals within the boreholes to provide 'N' values for empirical assessment of strength and density parameters. A summary of the findings is presented in Table 3 below:

Table 3: Standard penetration test results

Stratum / Geological Origin	Range of SPT 'N' Values	Number of Tests	Comments	Derived Values Range of cu
Oxford Clay	7 to 45 (av. 22)	14	1.2-2.3m bgl: N = 7 to N = 12 (Low to Medium Strength)	30 - 50kPa
			2.40-6.45m bgl: N = 22 to N = 45 (High to Very High Strength)	90 - 180kPa

6.2 In-Situ CBR Testing

In-situ CBR tests, using a Dynamic Cone Penetrometer (TRL DCP), were undertaken within the existing highway/unnamed access roads along the proposed road course. CBR values were derived at a range of depths ranging from 0.57m to 1.86m bgl. The results of CBR testing are summarised in the Table 4 below, in TRL DCP logs in Appendix C and presented graphically in Appendix C:

Table 4: CBR test results

Stratum / Geological Origin	Type of Test	Range of CBR Values (%)	Characteristic CBR Value (%)	Comments
Made Ground 3/ Lower Roadstone	TRL DCP	6.7 – 9.5	7	Tests undertaken near base of unit.
Oxford Clay	TRL DCP	2.6 – 70	4	Oxford Clay typically recorded as a firm and stiff clay, hence suggest taking CV as 4%.
				High values considered to represent cobbles/obstructions.

In addition to the above assessment of near surface subgrade, consideration should also be given to materials at deeper levels which will have a more significant effect on the long-term settlement of the proposed roadway, pavement and cycleway. Particular consideration should be given to the potential impact tree removal will have on the shrink/swell characteristics of the underlying Oxford Clay.

6.3 In Situ Vane Tests

Hand vane tests to approximate shear strength were undertaken at selected depths within trial pits. The results of these tests are included on the exploratory hole logs in Appendix B, graphically in Appendix C and a summary is presented in Table 5 below:

Table 5: In-situ Vane Test results

Location ID & Stratum	Depth (m bgl)	Type of Test	Result (kPa)
RC701 – Firm CLAY	0.75	Hand Vane	62
RC702 – Firm CLAY	1.00	Hand Vane	52
RC704 – Firm CLAY	0.75	Hand Vane	63
RC705 – Firm CLAY	1.00	Hand Vane	55
RC706 – Firm CLAY	1.00	Hand Vane	70
RC707- Firm CLAY	1.00	Hand Vane	54
RC708 – Firm CLAY	0.65	Hand Vane	76
TP329 – Firm CLAY	1.50	Hand Vane	65
TP801 – Firm CLAY	0.60	Hand Vane	62
TP801 – Firm CLAY	1.50	Hand Vane	72
TP801 – Stiff CLAY	2.50	Hand Vane	83
TP829 – Firm CLAY	0.50	Hand Vane	61
TP829 – Firm CLAY	1.00	Hand Vane	72
TP829 – Stiff CLAY	2.00	Hand Vane	84

6.4 Geotechnical Laboratory Testing

Representative soil samples from the Site were scheduled for:

- Natural moisture content and plasticity index;
- pH and water soluble sulphate (SD1 Suite);
- Particle Size Distribution Analysis;
- Undrained Shear Strength Triaxial Tests; and
- Compaction Testing.

The results are summarised below and presented in Appendix C.

6.4.1 Natural Moisture Content and Plasticity Index

Representative samples of natural cohesive material were taken for moisture content and plasticity index determinations. The test results are included in Appendix C and are summarised in Table 6 below. The modified plasticity index can be used as an indicator of volume change potential of the soil and is calculated as the plasticity index of the soil multiplied by the fraction of particles less than 425µm.

Table 6: Volume change potential

Stratum / Geological Origin	Range of Plasticity Indices % (Modified)	Volume Change Potential
Oxford Clay	23 to 46	Medium to High

Whilst the values stated above are indicative of the data, particular care should be given when designing roadways in this area of the Site. Due to historic loading of the clays underlying this area of the Site, differential settlement is likely, particularly when comparing areas of open ground and those previously occupied by buildings, such as building D5.

6.4.2 pH Value and Water Soluble Sulphate

The Aggressive Chemical Environment for Concrete classifications for the soil types identified at the site have been determined in accordance with BRE Special Digest 1:2005 (SD1). SD1 requires that sites are first identified as being in one of four categories based on natural ground/ 'Brownfield' conditions and pyrite content.

The results of the laboratory testing are included in Appendix C and summarised in Table 7 below:

Table 7: Summary of pH and sulphate analysis

Stratum/Geological Origin	Characteristic Water Soluble Sulphate Value (mg/l SO4)	Characteristic pH Value
Roadstone	2,200	10.3
Oxford Clay	1,700	4.2

As the characteristic pH is less than 5.5, the concentrations of magnesium, nitrate and chloride would be considered significant in determining the design sulphate class. However, as the design characteristic value of sulphate is less than 3,000mg/l, this is not deemed significant in determining the design sulphate class.

6.4.3 Particle Size Distribution

Particle Size distribution analysis was undertaken on 10 samples of the existing Made Ground and 1 sample of the underlying Clay. The results of laboratory testing are included in Appendix C and summarised in Table 8 below:

Table 8: Particle Size Distribution

Location ID	Depth (m bgl)	Stratum	Cobbles (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH702	0.10-0.30	Made Ground	0	19	3	-78-	
BH704	0.35-0.80	Made Ground	5	72	17	-6-	
BH705	0.20-0.50	Made Ground	25	58	13	-4-	
RC702	0.40	Made Ground	0	76	20	-4-	

Location ID	Depth (m bgl)	Stratum	Cobbles (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
RC705	0.50	Made Ground	84	13	2	-1-	
RC706	0.50	Made Ground	27	57	10	-6-	
RC707	0.50	Made Ground	34	53	8	-5-	
RC710	0.40	Made Ground	0	68	19	-13-	
RC801	0.60	Made Ground	74	14	6	-6-	
TP801	1.00-1.50	CLAY	0	0	5	39	56
TP704	0.30-0.80	Made Ground	0	0	2	42	56
TP329	0.10	Made Ground	0	17	13	35	35
TP425	0.50	Made Ground	0	16	15	30	39
CC501	0.19	Made Ground	0	73	19	8	

6.4.4 4.5kg Dry Density / Moisture Content Relationship Testing

Dry Density / Moisture Content Relationship testing was undertaken on a total of 3 samples of Oxford Clay and 6 samples of Made Ground to assess the feasibility of re-compaction of anticipated fill materials. The results of the compaction tests are presented within Appendix C and summarised below.

Table 9: Dry Density/Moisture Content Relationships Results

Stratum/Geological Origin	Sample Location & Depth (m bgl)	MDD (Mg/m^3)	Initial Moisture Content (%)	Optimal Moisture Content (%)	MDD? (>95%)	Air Voids? (<5%)
Roadstone	TP704 (0.30-0.80)	1.83	26.2	12.0	No	No
Made Ground 4 / Gravelly clay	TP329 (0.10)	1.69	35.2	15.0	No	No
	TP425 (0.50)	1.70	37.1	18.0	No	No
	TP702 (0.60)	1.69	25.5	15.5	No	No
	TP703 (0.60)	1.67	26.3	18.5	No	No
	TP802 (0.30)	1.76	25.0	12.5	No	No
Oxford Clay	TP801 (1.00-1.50)	1.71	29.9	13.0	No	No
	TP704 (2.60-2.90)	1.80	26.8	11.0	No	No

Stratum/Geological Origin	Sample Location & Depth (m bgl)	MDD (Mg/m^3)	Initial Moisture Content (%)	Optimal Moisture Content (%)	MDD? (>95%)	Air Voids? (<5%)
	TP825 (0.80–1.10)	1.52	32.3	20.8	No	No

The compaction data has been assessed by comparing the results against criteria commonly used in earthworks to achieve an adequate density for engineered fills. The criteria summarised in the above table indicate whether the samples could achieve in excess of 95% of maximum dry density (a requirement often included in highways specifications) and whether they could be compacted to less than 5% air voids ratio.

Clays tested from locations within the Site have recorded high initial moisture contents which deems that they would be unsuitable for compaction and use as an engineered earthwork fill unless allowed to dry or treated via use of lime stabilisation.

6.4.5 Undrained Triaxial Testing

Shear strength of the natural superficial strata was determined by quick undrained triaxial tests (multi-stage) on single 100mm diameter specimens at a series of confining pressures. The results of these tests are presented in Appendix C, and are summarised in Table 10 below:

Table 10: Triaxial test results

Location ID (depth mbgl) / Geological Origin	Undrained Shear Strength	Comments
BH319 (2.20 – 2.65) / CLA	27kPa	Low Strength
BH702 (3.40 – 3.85) / CLAY	79kPa	Medium Strength – Fractures and voids present
BH802 (2.30 – 2.75) / CLAY	59kPa	Medium Strength
BH803 (1.20 – 1.65) / CLAY	72kPa	Medium Strength
BH803 (3.40 – 3.85) / CLAY	88kPa	High Strength
BH803 (6.00 – 6.45) / CLAY	137kPa	High/Very High Strength
BH807 (1.20) / CLAY	67kPa	Medium Strength
BH807 (3.50 – 3.95) / CLAY	99kPa	High Strength

6.5 Excavations, Trench Shoring & Dewatering

All trenches should be excavated in accordance with CIRIA Report 97 'Trenching Practice'. Comments relating to the stability of excavations (i.e. trial pits) and groundwater seepages are included in the logs in Appendix B and a summary of the stability is provided in Table 11 below.

Table 11: Stability of excavations and groundwater flows

Stratum / Geological Origin	Stability / Seepages	Comments
All Made Ground types	Trial Pits remained stable. Seepages recorded in RC703 and TP707 within Made Ground. Fast inflow recorded in RC709	Excavations likely to be stable in the short term. The cohesive materials will deteriorate significantly in inclement weather. Any excavations requiring man entry, should be shored or formed with safe batters. Seepages recorded in RC703 at 69.56m AOD (0.4m bgl) and in TP707 at 71.93m AOD (0.5m bgl). These are considered to represent perched waters. Any excavations to these depths may need localised dewatering. Fast inflow recorded in RC709 at 70.60m AOD (0.28m bgl) along the current Anniversary Avenue and the proposed roadway route. Again, localised dewatering may be required .
Oxford Clay	Trial Pits remained stable. Seepages recorded in TP702, TP704, TP801, TP803 within Oxford Clay.	Excavations likely to be stable in the short and long term. The cohesive materials will deteriorate significantly in inclement weather. Any excavations requiring man entry, should be shored or formed with safe batters. Seepage recorded at 68.23m AOD and 69.73m AOD in TP702, 71.33m AOD in TP704, 67.57m AOD in TP801 and at 66.83m AOD along the proposed roadway route. These are considered to represent perched waters. Any excavations to this depth may need localised dewatering.

7. Generic Environmental Assessment Criteria

The information requirements for generic quantitative risk assessment will depend on:

- The substance being assessed;
- The receptors being considered;
- The pathways being considered; and
- The complexity of the site.

In view of the proposed development comprising a new road with footways and limited soft landscaping, the outline conceptual model developed for the site has identified 2 potential contaminant linkages. The risk on the adjacent development site area are assessed in separate reports. These potential contaminant linkages have been investigated and the results assessed against generic assessment criteria. The generic assessment criteria selected for each potential contaminant linkage are summarised in Table 12 below:

Table 12: Generic assessment criteria

Source	Pathway	Receptor	Generic Assessment Criteria
Contaminated Soils	Direct contact, inhalation, ingestion	Construction workers	Category 4 Screening Levels (C4SLs), LQM/CIEH S4ULs (Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3060. All rights reserved), CL:AIRE (2009) PAH assessment using Benzo(a)pyrene surrogate marker assessment
Mobile contaminants associated with historical uses of the Site.	Leaching, migration through preferential pathways/existing drainage ditches.	Adjacent watercourses	Environmental Quality Standards

The generic assessment criteria used in this report are included in Appendix G.

8. Quantitative Environmental Risk Assessment – Risk Estimation

8.1 Regulatory Context

This contamination assessment has been undertaken in general accordance with the Land Contamination Risk Assessment (LCRM) 2020 (Environment Agency). The environmental risk assessment includes the following:

- outline Conceptual Model for the Site;
- results of Intrusive Ground Investigation;
- confirmation of Generic Assessment Criteria used to assess risks;
- assessment of results against Generic Assessment Criteria;
- identification of potentially unacceptable risks; and
- recommendations for further action.

This report forms a decision record for the contaminant linkages identified, the generic assessment criteria used to assess risks, the unacceptable risks identified and the proposed next steps in relation to the site. The report also provides an explanation of the refinement of the outline conceptual model following the ground investigation, the selection of criteria and assumptions, the evaluation of potential risks and the basis for the decision on what happens next.

The assessment is in respect of the construction of a new spine road (EAR), cycleways and pedestrian footpaths and limited soft landscaping.

In order to assess the contamination status of the Site, with respect to the proposed end use, it is necessary to assess whether the Site could potentially be classified as “Contaminated Land”, as defined in Part IIA of the Environmental Protection Act 1990 and Contaminated Land Statutory Guidance 2012. This is assessed by the identification and assessment of potential contaminant linkages. The linkage between the potential sources and potential receptors identified needs to be established and evaluated.

To fall within this definition, it is necessary that, as a result of the condition of the land, substances may be present in, on or under the land such that:

a) significant harm is being caused or there is a significant possibility of such harm being caused; or

b) significant pollution of controlled waters is being caused, or there is significant possibility of such pollution being caused.

It should be noted that DEFRA has advised (Ref. Section 4, DEFRA Contaminated Land Statutory Guidance 2012) Local Authorities that land should not be designated as “Contaminated Land” where:

a) the relevant substance(s) are already present in controlled waters;

b) entry into controlled waters of the substance(s) from land has ceased; and

c) it is not likely that that further entry will take place.

These exclusions do not necessarily preclude regulatory action under the Environmental Permitting (England and Wales) Regulations 2016, which make it a criminal offence to cause or knowingly permit a water discharge of any poisonous, noxious or polluting matter to controlled waters. In England and Wales, under The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009, a works notice may be served by the regulator requiring appropriate investigation and clean-up.

8.2 Risk to Human Health

The following chemical contamination testing was carried out:

Roadstone beneath existing Anniversary Avenue and unnamed access roads

- 7 no. samples screened for asbestos fibres;
- 2 no. samples for BRE SD1 Suite (Short);
- 6 no. samples for heavy metals and speciated PAHs;
- 1 no. sample for phenols;
- 5 no. samples for TPH and BTEX;

Topsoil

- 1 no. sample for heavy metals and speciated PAHs;
- 1 no. sample for soil organic matter (SOM).

Asphalt

- 2 no. samples for speciated PAHs;
- 2 no. samples for Phenols;

Made Ground

- 2 no. samples screened for heavy metals and speciated PAHs;
- 1 no. sample screened for asbestos fibres;

Stockpile

- 2 no. samples screened for asbestos fibres;
- 1 no. sample for PAHs;

Natural Clays

- 3 no. samples for BRE SD1 Suite (Short);
- 2 no. samples for BRE SD1 Suite (Full);
- 2 no. samples for speciated TPH;
- 1 no. sample for BTEX;

Swale Sediment testing locations

- 11 no. samples for heavy metals;
- 7 no. samples for speciated PAHs;
- 2 no. samples for TPH CWG and BTEX/MTBE;

Concrete Coring

- 1 no. sample for heavy metals, speciated PAHs, TPH CWG and BTEX/MTBE;
- 1 no. sample screened for asbestos fibres.

When screened against assessment criteria for a commercial end use, no exceedances of heavy metals or TPH fractions were recorded. Exceedances of individual PAHs were recorded, and these are detailed below in Table 13 and are shown on the Drawings (*ref: WIE11386-139-87-101-EAR-Commerical Exceedances - A01 Sheet 1- Sheet 8*), included in Appendix E.

No asbestos fibres were recorded in any of the samples screened.

Table 13: Summary of generic quantitative risk assessment for human health – Commercial

Stratum / Source / Zone	Contaminant	Location, depth (m bgl)	Conc. (mg/kg)	Generic Assessment Criteria (mg/kg)
Asphalt	Benzo(a)anthracene	RC706 (0.2)	**180.00**	170.00
	Benzo(b)fluoranthene		**170.00**	44.00
	Benzo(a)pyrene		**160.00**	35.00
	Benzo(a)anthracene	RC709 (0.15)	**410.00**	170.00
	Chrysene		**360.00**	350.00
	Benzo(b)fluoranthene		**380.00**	44.00
	Benzo(a)pyrene		**360.00**	35.00
	Di-benzo(a.h.)anthracene		**24.00**	3.60
	Benzo(b)fluoranthene	RC701 (0.20)	**74.00**	44.00
	Benzo(a)pyrene		**76.00**	35.00
	Di-benzo(a.h.)anthracene		**4.50**	3.60

The samples of asphalt tested from RC706 and 709 recorded total PAH concentrations well in excess of 1000mg/kg which suggests the present of coal tars within the material.

8.3 Risk to Controlled Waters

The recorded concentrations are not considered to represent a risk to controlled water receptors. One exceedance of TPH Aromatic EC21-EC35 was recorded. This was noted from a sample of asphalt taken from TP830 (0.05m bgl) and so is not anticipated to represent a risk to controlled waters at the site.

8.4 Risk to Construction Workers

Exceedances of individual PAHs were recorded within Asphalt within RC701, RC706 and RC709 when compared against a commercial end use generic assessment criteria (GAC). Widespread contamination has not been recorded at the Site which would represent a significant risk to construction workers. Locations recording elevated levels of PAHs are within the current Anniversary Avenue roadway which is proposed to be replaced as part of the redevelopment of the Site. Construction workers must adhere to good practices hygiene during works. Any soils intended for re-use on Site or disposal must be assessed for their suitability.

Whilst no asbestos has been recorded in this area of the Site, other than in 4 locations along the former heating pipeline, construction workers must adhere to good practices for maintaining hygiene during works. If asbestos is discovered this should be removed and disposed with by competent persons in accordance with relevant best practice.

As part of protection against the potential risk posed by contamination in near surface soils and potential asbestos, the mandatory use of PPE and RPE when operating within areas of known contamination should be adhered to at all times and provisions should be made for appropriate Site hygiene and welfare facilities and dedicated food preparation and eating areas.

Given the nature of the current site use, and that asbestos has been encountered in other areas of the Site, all personnel must have asbestos awareness training.

8.5 Ground Gas

A maximum elevated carbon dioxide concentration of 18.6% v/v was recorded within the monitoring standpipes, although no significant gas flow was recorded. In addition, no concentrations of methane were recorded.

Hence in view of the recorded concentrations, construction workers entering excavations shall wear respiratory protective equipment (RPE) to mitigate the risk posed by oxygen depletion as the result of elevated carbon dioxide.

9. Geotechnical Assessment

9.1 Proposed Development

This assessment has been prepared on the understanding that the site is to be redeveloped with the introduction of new highways, a roundabout, walkways, and cycleways. If development proposals change, it may be necessary to revise the conclusions and recommendations made in this report and Waterman IE should be contacted to provide further advice.

9.2 Characteristic Values

The results of the intrusive ground investigation in this area of the Site have confirmed that the Site is typically underlain by Made Ground (topsoil), and where roads have been constructed, by the construction make-up which on Anniversary Avenue is asphalt and roadstone, whilst on the unnamed access roads includes gravelly and sandy Made Ground including ash, brick and slag.

The Made Ground is underlain by firm to stiff Oxford Clays.

9.2.1 Shrinkability / Volume Change Potential

Oxford Clay has been shown to have a high plasticity and medium to high volume change potential. A Plasticity Index of 50% should be adopted for the Oxford Clay at this location.

Considerable care should be taken when accounting for differential settlement across the course of the proposed roadway in this area of the Site. Oxford Clays underlying former buildings, in particular in the area of D5 are likely to heave to a significant extent, whereas those underlying open ground will be anticipated to settle under loading from the proposed road surface.

9.2.2 Design Class for Buried Concrete

Buried concrete & precast concrete manhole rings and pipework shall be in accordance with BRE Special Digest 1:2005 “Concrete in aggressive ground”, (SD1), Table C2 “Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations”:

- Concrete in contact with the existing roadstone: Design Sulphate Class DS-3 and ACEC Class AC-2.
- Concrete in contact with Oxford Clay: Design Sulphate Class DS-3 and ACEC Class AC-3s.

9.2.3 Earthworks

The results of compaction testing undertaken on samples of Oxford Clay indicate that the Natural Moisture content is significantly in excess of the optimum moisture content and hence the near surface materials would not be suitable in their current for use as an earthworks material, unless the materials are allowed to dry or are treated to reduce the moisture content (i.e. lime stabilisation).

9.2.4 Pavement Design

The existing Anniversary Avenue and unnamed access roads comprises of three different construction make ups:

- 130mm to 250mm of bituminous surface over 420mm to 620mm of roadstone is recorded.
- Unnamed access roads: 80mm to 110mm of bituminous surface over 390mm to 820mm of roadstone.
- Hardstanding along proposed road course: 300mm of concrete over 100mm of granular Made Ground, 100mm of concrete and 300mm of cohesive Made Ground.

In all locations Bituminous surfacing and Made Ground is underlain by firm to stiff clay.

In-situ CBR values of the firm clays immediately below the existing roadstone recorded values of between 6.7 and 9.5% with the underlying strata giving values of between 2.6 and 70%. In view of the high plasticity

of the clays and their susceptibility to rapid softening, it is recommended that a design CBR of 4% be adopted for the natural clay soils. Further testing once the final formation level is known, using plate load testing equipment should be undertaken to confirm the design CBR value.

During construction, the in-situ CBR value must be checked against the Design CBR value, to confirm design requirements are being met.

9.2.5 Groundwater and Stability of Excavations

Comments relating to the stability of excavations (i.e. trial pits) and groundwater seepages are included in the logs included in Appendix B. The groundwater level measured adjacent to Building D1 in BH703 was circa 3.6m below existing ground level.

Based on observation made during fieldwork, shallow excavations (<1.2m) are likely to remain stable in the short term.

Should water ingress be encountered in excavations, it is anticipated that this could be adequately controlled by simple sump pumping techniques.

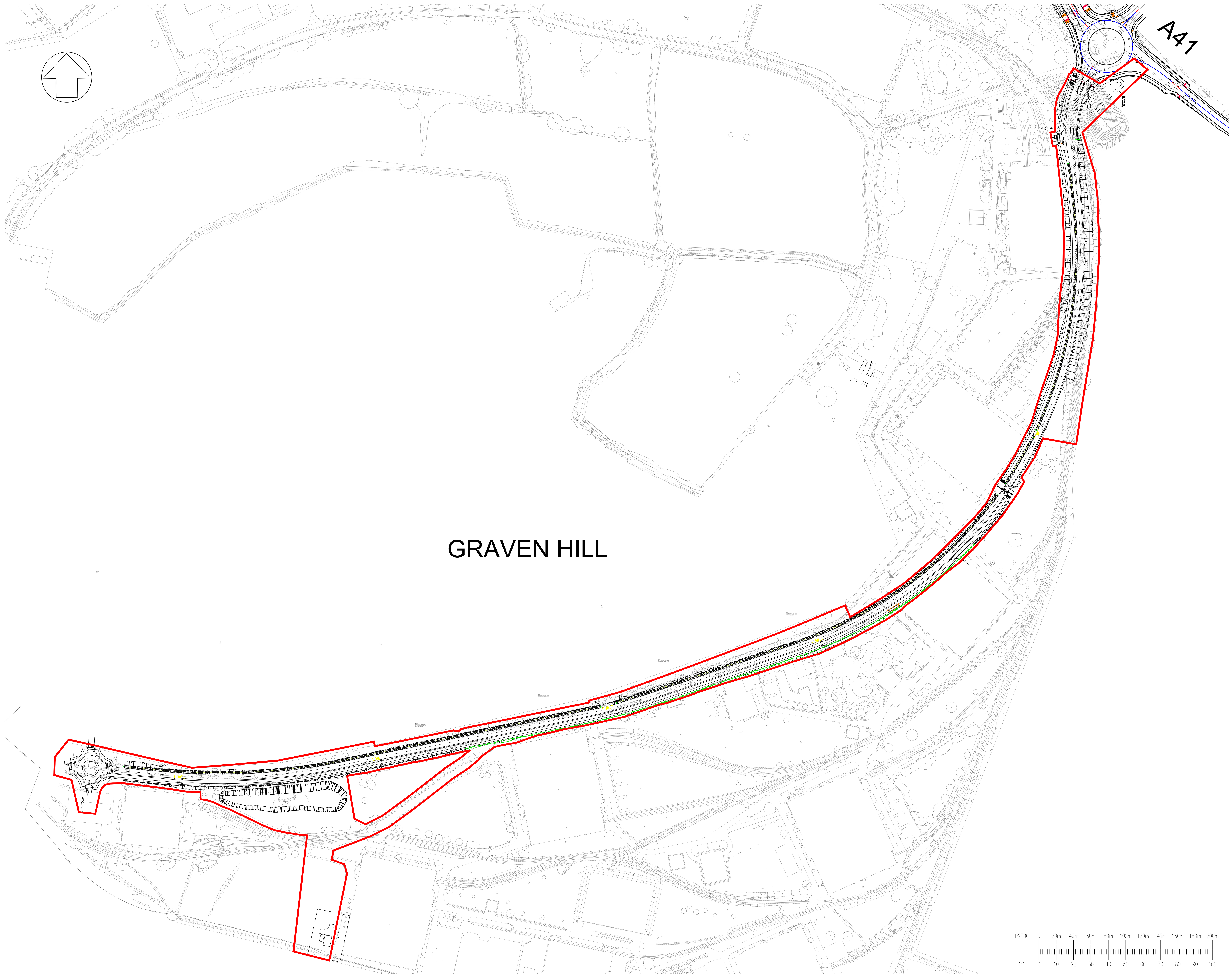
In addition:

- Any trenches should be excavated in accordance with CIRIA Report 97 'Trenching Practice';
- In line with BS6031, all excavations should be examined daily by a competent person to ensure that they remain safe. Where the sides cannot be sloped back to a safe angle, as approved by a competent and experienced person, their continued stability should not be taken for granted. Vertical or steep faces should be provided with support unless instructed otherwise by a competent person.

APPENDICES

Appendix A Site Plans

- **Site Location Plan (WIE11386-EAR-90-001-Red Line Boundary-A05)**
- **Site Proposals (WIE11386-EAR-90-101-GA-A06 Sheet 1 – Sheet 6)**
- **Exploratory Hole Locations (WIE11386-139-87-100-EAR GI Locations Sheet 1 – Sheet 7)**
- **Armac Heating Pipeline Asbestos Sampling Locations (ARMAC's_ Sampling Locations_009 Rev A)**



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KEY

EMPLOYMENT ACCESS ROAD RED LINE BOUNDARY

Rev	Date	Description	By
A05	05.03.21	ROAD OUTLINE AMENDED FOLLOWING OCC COMMENTS	AN
A04	11.02.21	DRAWING UPDATED TO ACCOMMODATE WESTERN RBT	AN
A03	22.01.21	DRAWING UPDATED FOLLOWING OCC COMMENTS	AN
A02	12.08.20	SITE BOUNDARY AND DEMOLITION PLAN ADDED	AN
A01	24.07.20	FIRST ISSUE	JG

Amendments

Project
GRAVEN HILL, BICESTER

Title
EMPLOYMENT ACCESS ROAD
RED LINE BOUNDARY

Client
Graven Hill Village Development Company Limited

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Drawing Status
PRELIMINARY

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Scales @ A1 work to figured dimensions only		1:2500		Computer File No WIE11386-EAR-90-001 - Red Line Boundary.dwg

Publisher	Zone	Category	Number	Revision
WIE	EAR	90	001	A05

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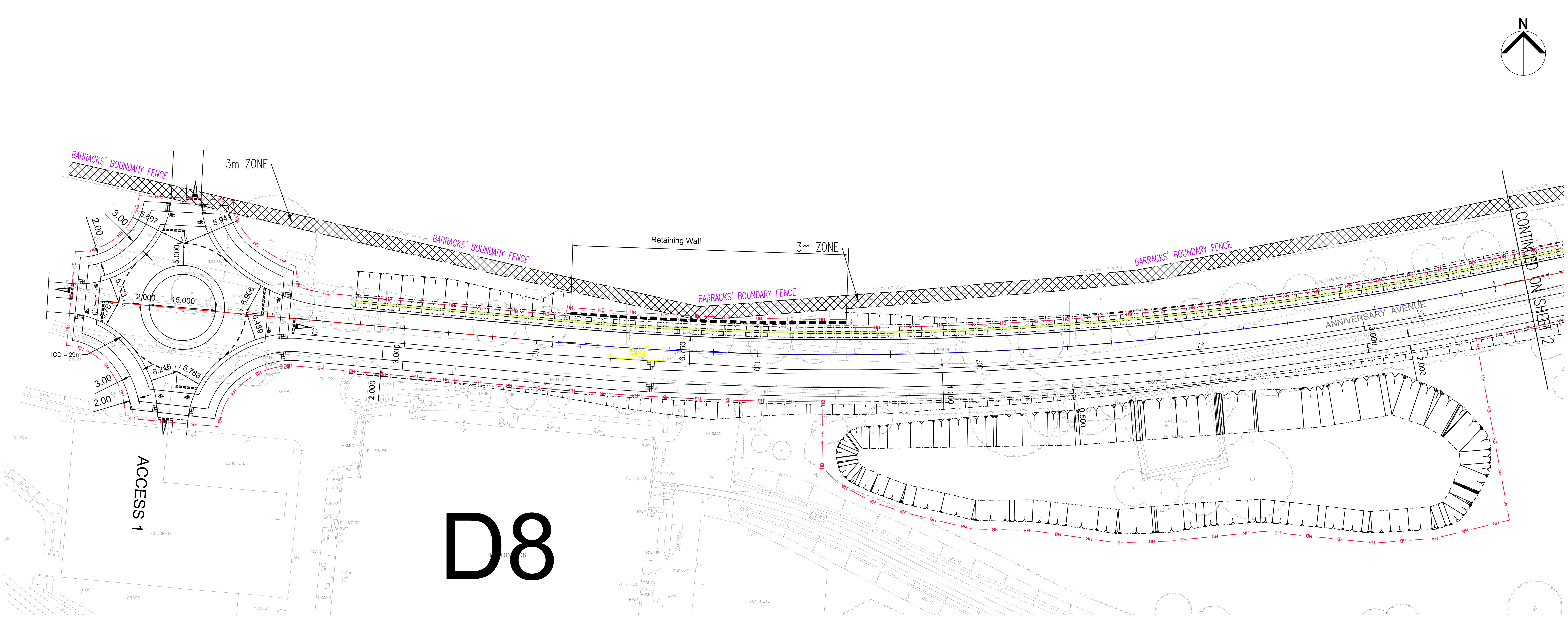

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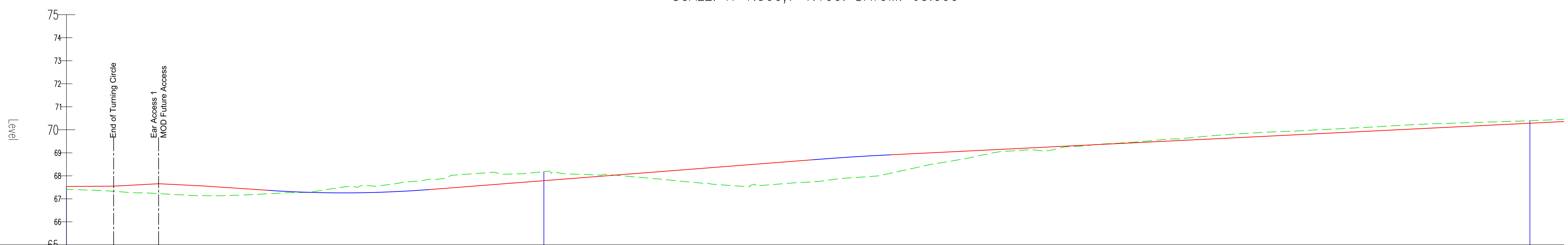

Chainage	00.000	05.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
Proposed C/L Levels	67.537	67.544	67.550	67.602	67.657	67.607	67.556	67.489	67.421	67.354	67.302
Existing Levels	67.413	67.378	67.332	67.262	67.228	67.171	67.138	67.145	67.182	67.235	67.273

Chainage	55.000	60.000	65.000	70.000	75.000	80.000	85.000	90.000	95.000	100.000	105.000
Proposed C/L Levels	67.270	67.259	67.269	67.300	67.352	67.424	67.501	67.579	67.657	67.735	67.812
Existing Levels	67.358	67.512	67.573	67.617	67.755	67.842	68.045	68.116	68.069	68.113	68.173

Chainage	110.000	115.000	120.000	125.000	130.000	135.000	140.000	145.000	150.000	155.000	160.000
Proposed C/L Levels	67.890	67.968	68.046	68.124	68.201	68.279	68.357	68.435	68.512	68.590	68.668
Existing Levels	68.076	68.038	68.012	67.923	67.833	67.738	67.640	67.569	67.568	67.647	67.720

Chainage	165.000	170.000	175.000	180.000	185.000	190.000	195.000	200.000	205.000	210.000	215.000
Proposed C/L Levels	68.744	68.813	68.873	68.925	68.975	69.024	69.073	69.123	69.172	69.222	69.271
Existing Levels	67.802	67.910	67.980	68.163	68.381	68.573	68.738	68.948	69.082	69.124	69.178

Chainage	220.000	225.000	230.000	235.000	240.000	245.000	250.000	255.000	260.000	265.000	270.000
Proposed C/L Levels	69.321	69.370	69.420	69.469	69.518	69.568	69.617	69.667	69.716	69.766	69.815
Existing Levels	69.292	69.383	69.444	69.520	69.601	69.673	69.764	69.829	69.888	69.932	69.981

Chainage	275.000	280.000	285.000	290.000	295.000	300.000	305.000	310.000	315.000	320.000	325.000
Proposed C/L Levels	69.864	69.914	69.963	70.013	70.062	70.112	70.161	70.211	70.260	70.309	70.359
Existing Levels	70.031	70.084	70.140	70.198	70.248	70.282	70.314	70.345	70.376	70.414	70.453

Horizontal Geometry: L =103.617 | L =278.799

Vertical Geometry: G =0.123% L =10.250 | G =1.097% L =9.750 | G =-1.000% L =9.742 | G =-1.349% L =14.167 | R =1200.000 K =12.000 L =34.861 | G =1.556% L =83.201 | R =3000.000 K =30.000 L =17.007 | G =0.989% L =212.507

1:500 0 10m 20m 30m 40m 50m

1:1 0 10 20 30 40 50 60 70 80 90 100

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KEY:

— HB — HIGHWAY BOUNDARY

90m FORWARD VISIBILITY

Rev	Date	Description	By
A06	05.03.21	ROAD OUTLINE AMENDED FOLLOWING OCC COMMENTS	AN
A05	11.02.21	RBT UPDATED IN ACCORDANCE WITH LTM 1 / 20	AN
A04	22.01.21	DESIGN UPDATED IN ACCORDANCE WITH OCC COMMENTS	DP
A03	24.07.20	ACCESS LOCATIONS AND LAYOUTS	NJH
A02	17.06.20	FOOTWAY AND CYCLE TRACK ALIGNMENT.	NJH
A01	22.04.20	FIRST ISSUE	NJH

Amendments

Project
GRAVEN HILL, BICESTER

Title
EMPLOYMENT ACCESS ROAD GENERAL ARRANGEMENT SHEET 1

Client
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Drawing Status
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Designed by	JG	Checked by	DP	Project No	WIE11386
Drawn by	AN	Date	APR 2020		
Scales @ A1 work to figured dimensions only	1:500			Computer File No	WIE11386-EAR-90-100 to 106 - GA - A03.dwg

Publisher	Zone	Category	Number	Revision
WIE	EAR	90	101	A06

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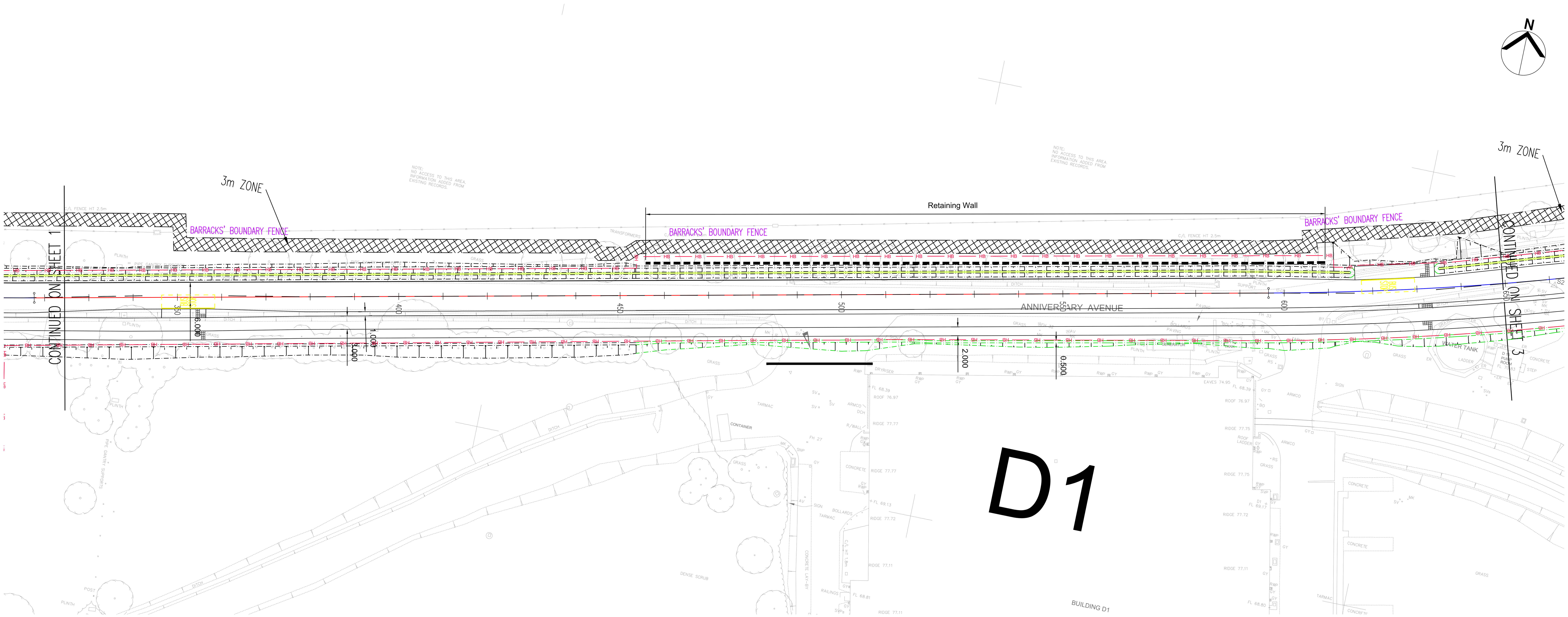

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KEY:

HB — HIGHWAY BOUNDARY

90m FORWARD VISIBILITY

EMPLOYMENT ACCESS ROAD - LONGSECTION CH325-650
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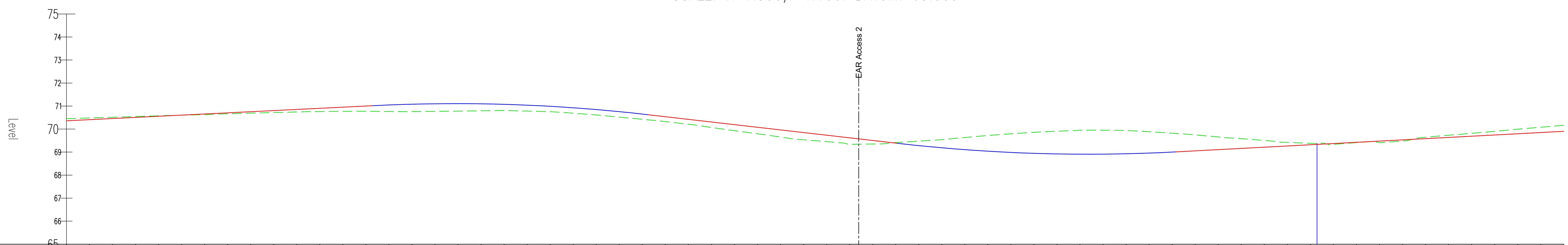


Chainage	Proposed C/L Levels	Existing Levels
325.000	70.359	70.453
330.000	70.408	70.484
335.000	70.458	70.516
340.000	70.507	70.546
345.000	70.557	70.577
350.000	70.606	70.605
355.000	70.655	70.633
360.000	70.705	70.664
365.000	70.754	70.692
370.000	70.804	70.720
375.000	70.853	70.746
380.000	70.903	70.763
385.000	70.952	70.773
390.000	71.002	70.776
395.000	71.048	70.766
400.000	71.080	70.762
405.000	71.100	70.772
410.000	71.105	70.781
415.000	71.097	70.797
420.000	71.075	70.809
425.000	71.039	70.784
430.000	70.990	70.759
435.000	70.926	70.689
440.000	70.849	70.616
445.000	70.759	70.521
450.000	70.654	70.427
455.000	70.540	70.326
460.000	70.425	70.212
465.000	70.310	70.071
470.000	70.195	69.933
475.000	70.080	69.798
480.000	69.966	69.655
485.000	69.851	69.534
490.000	69.736	69.458
495.000	69.621	69.338
500.000	69.506	69.353
505.000	69.392	69.414
510.000	69.283	69.476
515.000	69.188	69.543
520.000	69.106	69.637
525.000	69.039	69.724
530.000	68.986	69.795
535.000	68.946	69.862
540.000	68.921	69.907
545.000	68.909	69.948
550.000	68.911	69.951
555.000	68.927	69.937
560.000	68.957	69.889
565.000	69.001	69.821
570.000	69.054	69.750
575.000	69.107	69.659
580.000	69.160	69.586
585.000	69.213	69.506
590.000	69.266	69.422
595.000	69.319	69.384
600.000	69.372	69.336
605.000	69.425	69.412
610.000	69.478	69.413
615.000	69.531	69.482
620.000	69.584	69.649
625.000	69.637	69.734
630.000	69.690	69.819
635.000	69.743	69.904
640.000	69.796	69.995
645.000	69.849	70.080
650.000	69.902	70.166

Horizontal Geometry: L =278.799; R: 720.000 L: 85.673

Vertical Geometry: G =0.989% L =212.507; R =1820.072 K =18.201 L =59.795; G =-2.297% L =54.101; R =1800.000 K =18.000 L =60.427; G =1.061% L =122.942

1:500 0 10m 20m 30m 40m 50m
1:1 0 10 20 30 40 50 60 70 80 90 100

Rev	Date	Description	By
A06	05.03.21	ROAD OUTLINE AMENDED FOLLOWING OCC COMMENTS	AN
A05	11.02.21	RAISED TABLE AMENDED	AN
A04	22.01.21	DESIGN UPDATED IN ACCORDANCE WITH OCC COMMENTS	DP
A03	24.07.20	ACCESS LOCATIONS AND LAYOUTS	NJH
A02	17.06.20	FOOTWAY AND CYCLE TRACK ALIGNMENT	NJH
A01	22.04.20	FIRST ISSUE	NJH

Amendments

Project
GRAVEN HILL, BICESTER

Title
EMPLOYMENT ACCESS ROAD GENERAL ARRANGEMENT SHEET 2

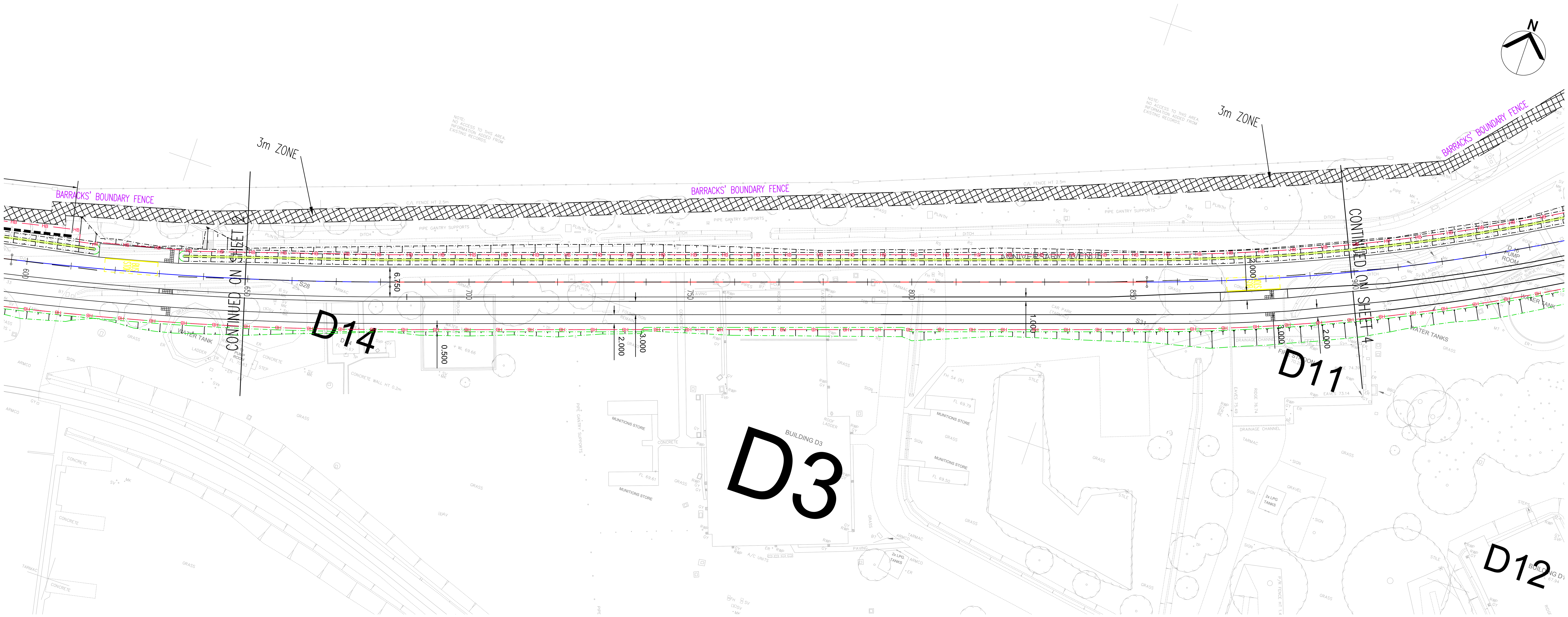
Client
Graven Hill Village Development Company Limited

Waterman
5th Floor One Cornwall Street Birmingham B3 2DX
t 0121 212 7700
mail@watermangroup.com www.watermangroup.com

Drawing Status
PRELIMINARY

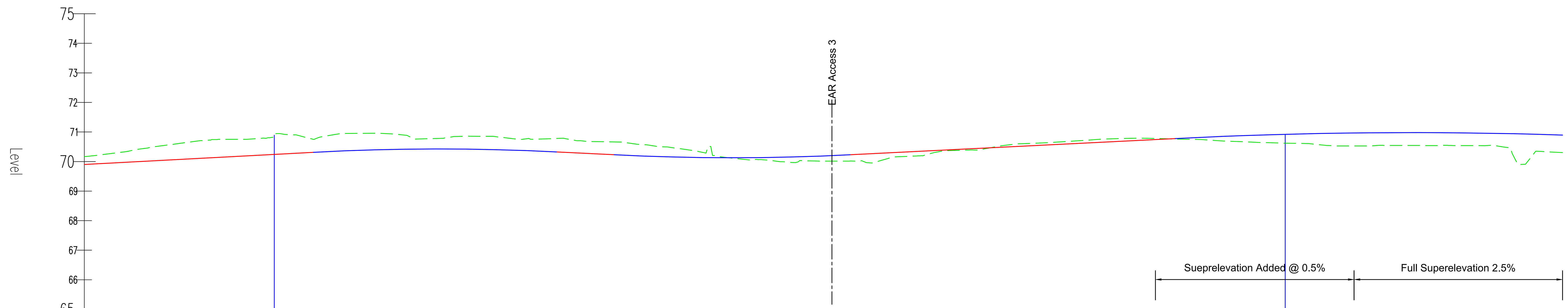
Designed by	JG	Checked by	DP	Project No	WIE11386
Drawn by	AN	Date	APR 2020	Computer File No	WIE11386-EAR-90-100 to 108 - GA - A03.dwg
Scales @ A1 work to figured dimensions only	1:500				

Publisher	Zone	Category	Number	Revision
WIE	EAR	90	102	A06



EMPLOYMENT ACCESS ROAD – LONGSECTION CH650–900

SCALE: H 1:500,V 1:100. DATUM: 65.000



Chainage	650.000	655.000	660.000	665.000	670.000	675.000	680.000	685.000	690.000	695.000	700.000
Proposed C/L Levels	69.902	69.955	70.008	70.061	70.114	70.167	70.220	70.273	70.326	70.370	70.401
Existing Levels	70.166	70.284	70.438	70.584	70.712	70.751	70.789	70.906	70.832	70.952	70.956

Chainage	705.000	710.000	715.000	720.000	725.000	730.000	735.000	740.000	745.000	750.000
Proposed C/L Levels	70.419	70.426	70.419	70.400	70.369	70.325	70.275	70.225	70.182	70.152
Existing Levels	70.843	70.783	70.857	70.831	70.775	70.781	70.679	70.662	70.568	70.454

Chainage	755.000	760.000	765.000	770.000	775.000	780.000	785.000	790.000	795.000	800.000
Proposed C/L Levels	70.134	70.129	70.136	70.156	70.188	70.233	70.283	70.333	70.383	70.433
Existing Levels	70.293	70.107	70.056	69.966	70.017	70.017	70.052	70.181	70.352	70.392

Chainage	805.000	810.000	815.000	820.000	825.000	830.000	835.000	840.000	845.000	850.000
Proposed C/L Levels	70.483	70.533	70.583	70.633	70.683	70.733	70.783	70.829	70.869	70.903
Existing Levels	70.530	70.614	70.663	70.728	70.775	70.784	70.760	70.729	70.677	70.639

Chainage	855.000	860.000	865.000	870.000	875.000	880.000	885.000	890.000	895.000	900.000
Proposed C/L Levels	70.931	70.952	70.967	70.976	70.978	70.974	70.964	70.948	70.926	70.897
Existing Levels	70.615	70.547	70.526	70.542	70.545	70.548	70.539	70.491	70.232	70.302

Horizontal Geometry			
	R: 720.000 L: 85.673	L =170.962	R: 480.000 L: 639.077

Vertical Geometry						
	G =1.061% L =122.942	R =2000.000 K =20.000 L =41.210	G =−1.000% L =9.648	R =2000.000 K =20.000 L =40.000	G =1.000% L =54.908	R =4000.000 K =40.000 L =90.000

1:500 0 10m 20m 30m 40m 50m

1:1 0 10 20 30 40 50 60 70 80 90 100

GENERAL NOTES

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6. ROAD LAYOUT AND HIGHWAY WORKS SHALL BE IN ACCORDANCE WITH DMRB AND OXFORD COUNTY COUNCIL (OCC) STANDARDS.

KEY:

HB — HIGHWAY BOUNDARY

90m FORWARD VISIBILITY

Rev	Date	Description	By
A06	05.03.21	ROAD OUTLINE AMENDED FOLLOWING OCC COMMENTS	AN
A05	22.01.21	DESIGN UPDATED IN ACCORDANCE WITH OCC COMMENTS	DP
A04	07.01.21	AMENDMENTS MADE FOLLOWING OCC COMMENTS	AN
A03	24.07.20	ACCESS LOCATIONS AND LAYOUTS	NJH
A02	17.06.20	FOOTWAY AND CYCLE TRACK ALIGNMENT	NJH
A01	22.04.20	FIRST ISSUE	NJH

Amendments

Project
GRAVEN HILL, BICESTER

Title
EMPLOYMENT ACCESS ROAD GENERAL ARRANGEMENT SHEET 3

Client
Graven Hill Village Development Company Limited

5th Floor One Cornwall Street Birmingham B3 2DX
t 0121 212 7700
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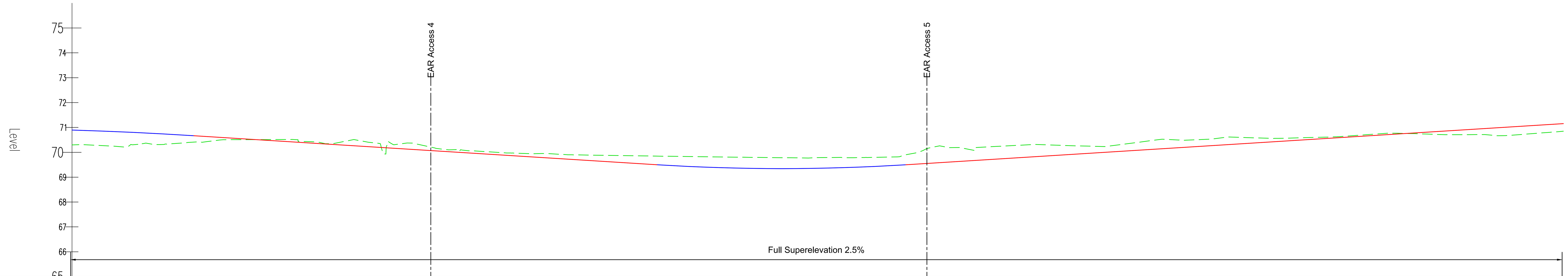
Drawing Status
PRELIMINARY

Designed by	JG	Checked by	DP	Project No	WIE11386
Drawn by	AN	Date	APR 2020		
Scales @ A1 work to figured dimensions only	1:500			Computer File No	WIE11386-EAR-90-100 to 106 - GA - A03.dwg

Publisher	Zone	Category	Number	Revision
WIE	EAR	90	103	A06

File Path \\s-bm\WIEL\Projects\WIE11386_GH0_LTA 2\#WO139_SERR_Got PO17_CAD\90_Civil\

EMPLOYMENT ACCESS ROAD - LONGSECTION CH900-1200
SCALE: H 1:500,V 1:100. DATUM: 65.000



Chainage	Proposed C/L Levels	Existing Levels
900.000	70.897	70.302
905.000	70.862	70.281
910.000	70.821	70.222
915.000	70.773	70.366
920.000	70.720	70.346
925.000	70.660	70.418
930.000	70.597	70.499
935.000	70.535	70.511
940.000	70.472	70.512
945.000	70.410	70.509
950.000	70.347	70.389
955.000	70.285	70.445
960.000	70.222	70.397
965.000	70.160	70.312
970.000	70.097	70.305
975.000	70.035	70.113
980.000	69.972	70.063
985.000	69.910	70.004
990.000	69.847	69.960
995.000	69.785	69.952
1000.000	69.722	69.901
1005.000	69.660	69.885
1010.000	69.597	69.870
1015.000	69.535	69.855
1020.000	69.473	69.840
1025.000	69.423	69.827
1030.000	69.385	69.814
1035.000	69.359	69.801
1040.000	69.346	69.789
1045.000	69.345	69.778
1050.000	69.357	69.786
1055.000	69.382	69.785
1060.000	69.419	69.793
1065.000	69.468	69.813
1070.000	69.529	69.988
1075.000	69.591	70.243
1080.000	69.654	70.135
1085.000	69.716	70.226
1090.000	69.779	70.279
1095.000	69.841	70.308
1100.000	69.904	70.272
1105.000	69.966	70.245
1110.000	70.029	70.287
1115.000	70.091	70.417
1120.000	70.154	70.520
1125.000	70.216	70.496
1130.000	70.279	70.551
1135.000	70.341	70.600
1140.000	70.404	70.567
1145.000	70.466	70.573
1150.000	70.529	70.599
1155.000	70.591	70.632
1160.000	70.654	70.703
1165.000	70.716	70.773
1170.000	70.779	70.751
1175.000	70.841	70.717
1180.000	70.904	70.711
1185.000	70.966	70.698
1190.000	71.029	70.695
1195.000	71.091	70.771
1200.000	71.154	70.850

Horizontal Geometry	
	L =639.077

Vertical Geometry				
	R =4000.000 K =40.000 L =90.000	G =-1.250% L =93.227	R =2000.000 K =20.000 L =50.000	G =1.250% L =222.080

1:500 0 10m 20m 30m 40m 50m
1:1 0 10 20 30 40 50 60 70 80 90 100

GENERAL NOTES

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6. ROAD LAYOUT AND HIGHWAY WORKS SHALL BE IN ACCORDANCE WITH DMRB AND OXFORD COUNTY COUNCIL (OCC) STANDARDS.

KEY:

HB — HIGHWAY BOUNDARY

90m FORWARD VISIBILITY

Rev	Date	Description	By
A06	05.03.21	ROAD OUTLINE AMENDED FOLLOWING OCC COMMENTS	AN
A05	22.01.21	DESIGN UPDATED IN ACCORDANCE WITH OCC COMMENTS	DP
A04	07.01.20	AMENDMENTS MADE FOLLOWING OCC COMMENTS	AN
A03	24.07.20	ACCESS LOCATIONS AND LAYOUTS	NJH
A02	17.06.20	FOOTWAY AND CYCLE TRACK ALIGNMENT	NJH
A01	22.04.20	FIRST ISSUE	NJH

Amendments

Project
GRAVEN HILL, BICESTER

Title
EMPLOYMENT ACCESS ROAD
GENERAL ARRANGEMENT
SHEET 4

Client
Graven Hill Village Development Company Limited

Waterman
5th Floor One Cornwall Street Birmingham B3 2DX
t 0121 212 7700
mail@watermangroup.com www.watermangroup.com

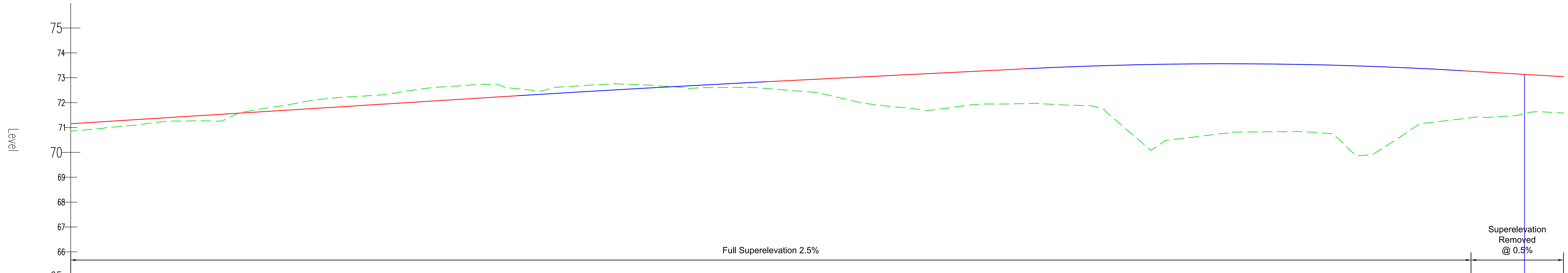
Drawing Status
PRELIMINARY

Designed by	JG	Checked by	DP	Project No
Drawn by	AN	Date	APR 2020	WIE11386
Scales @ A1 work to figured dimensions only	1:500			Computer File No WIE11386-EAR-90-100 to 108 - GA - A03.dwg

Publisher	Zone	Category	Number	Revision
WIE	EAR	90	104	A06

EMPLOYMENT ACCESS ROAD – LONGSECTION CH1200–1500

SCALE: H 1:500,V 1:100. DATUM: 65.000



Chainage	Proposed C/L Levels	Existing Levels
1200.000	71.154	70.850
1205.000	71.216	70.942
1210.000	71.279	71.042
1215.000	71.341	71.147
1220.000	71.404	71.252
1225.000	71.466	71.272
1230.000	71.529	71.256
1235.000	71.591	71.636
1240.000	71.654	71.802
1245.000	71.716	71.963
1250.000	71.779	72.131
1255.000	71.841	72.220
1260.000	71.904	72.278
1265.000	71.966	72.381
1270.000	72.029	72.534
1275.000	72.091	72.636
1280.000	72.154	72.703
1285.000	72.216	72.731
1290.000	72.279	72.554
1295.000	72.340	72.487
1300.000	72.401	72.649
1305.000	72.460	72.710
1310.000	72.518	72.752
1315.000	72.575	72.714
1320.000	72.631	72.654
1325.000	72.685	72.580
1330.000	72.738	72.606
1335.000	72.790	72.612
1340.000	72.841	72.563
1345.000	72.891	72.481
1350.000	72.941	72.410
1355.000	72.991	72.173
1360.000	73.041	71.959
1365.000	73.091	71.845
1370.000	73.141	71.741
1375.000	73.191	71.748
1380.000	73.241	71.885
1385.000	73.291	71.945
1390.000	73.341	71.955
1395.000	73.390	71.960
1400.000	73.433	71.902
1405.000	73.470	71.878
1410.000	73.501	71.297
1415.000	73.526	70.434
1420.000	73.545	70.474
1425.000	73.557	70.598
1430.000	73.563	70.720
1435.000	73.563	70.817
1440.000	73.556	70.826
1445.000	73.543	70.835
1450.000	73.524	70.807
1455.000	73.499	70.498
1460.000	73.468	69.883
1465.000	73.430	70.342
1470.000	73.386	71.002
1475.000	73.336	71.240
1480.000	73.279	71.360
1485.000	73.220	71.407
1490.000	73.161	71.473
1495.000	73.101	71.635
1500.000	73.042	71.585

Horizontal Geometry: R: 480.000, L: 639.077 | L =87.407

Vertical Geometry: G =1.250%, L =222.080 | R =20000.000, K =200.000, L =50.000 | G =1.000%, L =52.478 | R =4000.000, K =40.000, L =87.474 | G =−1.187%, L =187.516

1:500 0 10m 20m 30m 40m 50m
1:1 0 10 20 30 40 50 60 70 80 90 100

GENERAL NOTES

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6. ROAD LAYOUT AND HIGHWAY WORKS SHALL BE IN ACCORDANCE WITH DMRB AND OXFORD COUNTY COUNCIL (OCC) STANDARDS.

KEY:

HB — HIGHWAY BOUNDARY

90m FORWARD VISIBILITY

Rev	Date	Description	By
A06	05.03.21	ROAD OUTLINE AMENDED FOLLOWING OCC COMMENTS	AN
A05	22.01.21	DESIGN UPDATED IN ACCORDANCE WITH OCC COMMENTS	DP
A04	07.01.21	AMENDMENTS MADE FOLLOWING OCC COMMENTS	AN
A03	24.07.20	ACCESS LOCATIONS AND LAYOUTS	NJH
A02	17.06.20	FOOTWAY AND CYCLE TRACK ALIGNMENT	NJH
A01	22.04.20	FIRST ISSUE	NJH

Amendments

Project: GRAVEN HILL, BICESTER

Title: EMPLOYMENT ACCESS ROAD GENERAL ARRANGEMENT SHEET 5

Client: Graven Hill Village Development Company Limited

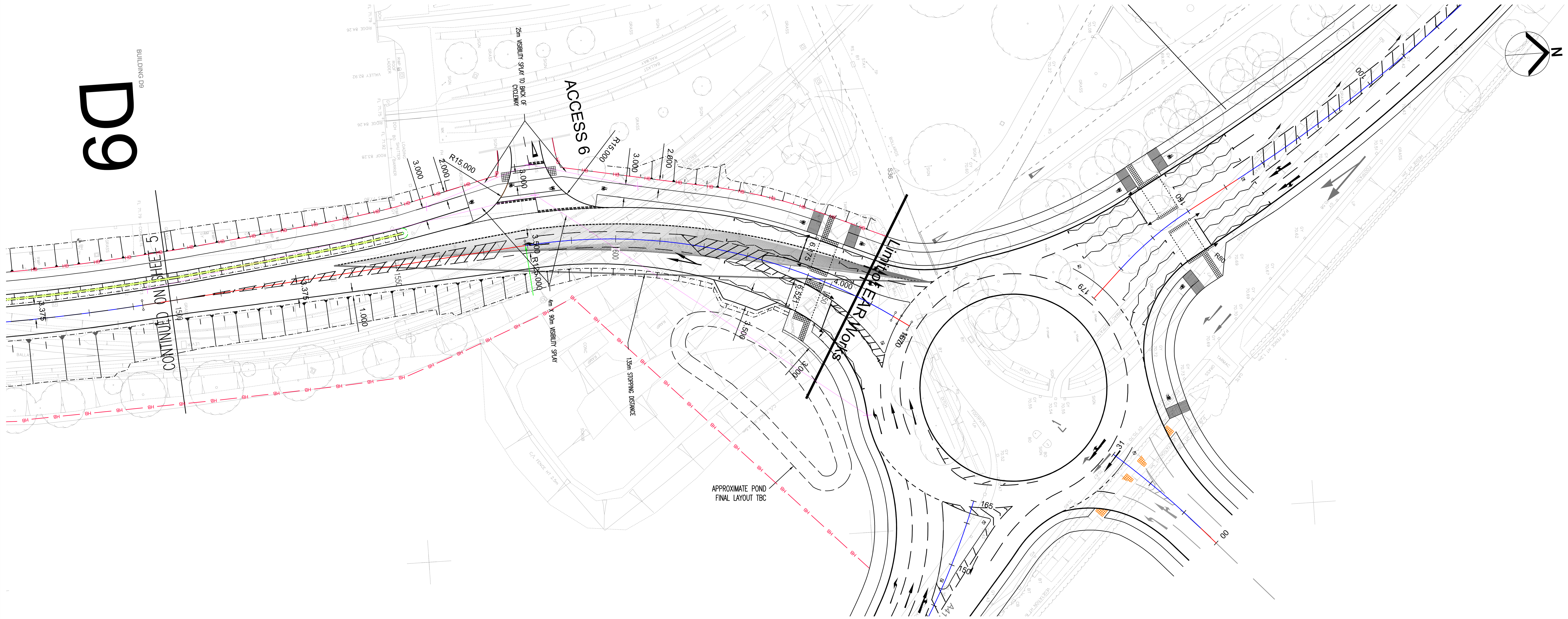
Waterman
5th Floor One Cornwall Street Birmingham B3 2DX
t 0121 212 7700
mail@watermangroup.com www.watermangroup.com

Drawing Status: PRELIMINARY

Designed by	JG	Checked by	DP	Project No	WIE11386
Drawn by	AN	Date	APR 2020		
Scales @ A1, work to figured dimensions only	1:500			Computer File No	WIE11386-EAR-90-100 to 106 - GA - A03.dwg

Publisher	Zone	Category	Number	Revision
WIE	EAR	90	105	A06

File Path \\s-bm\WIEL\Projects\WIE11386_GH0_LTA 2\#WO139_SERR_Got PO17_CAD\90_Civil\



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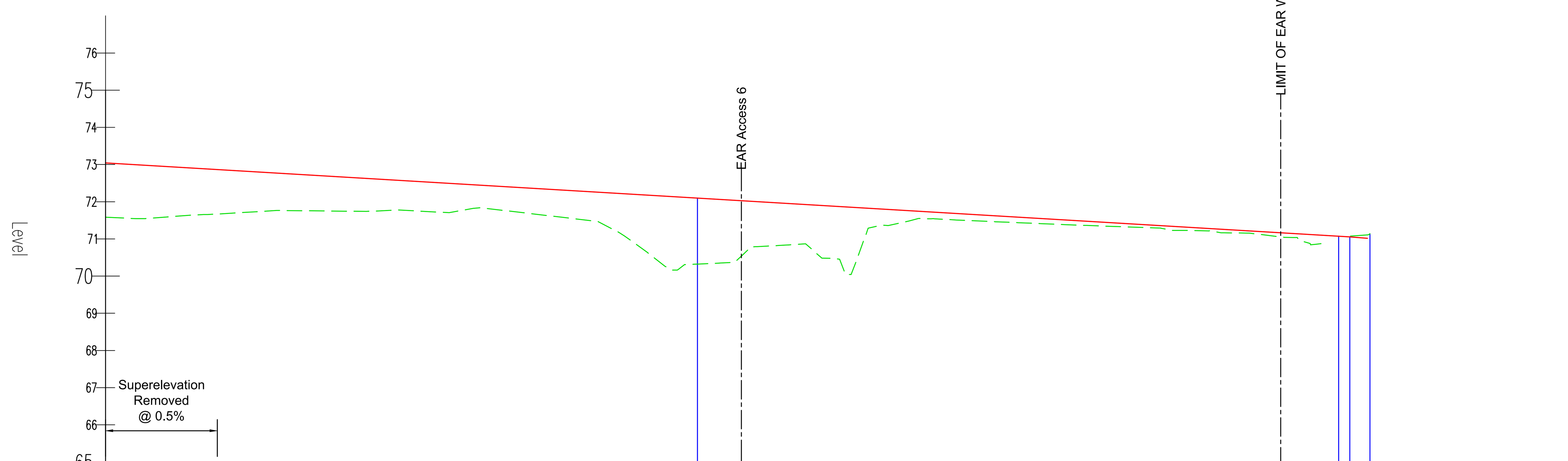
KEY:

HB — HIGHWAY BOUNDARY

90m FORWARD VISIBILITY

EMPLOYMENT ACCESS ROAD – LONGSECTION CH1500–END
SCALE: H 1:500,V 1:100. DATUM: 65.000



Chainage	1500.000	1505.000	1510.000	1515.000	1520.000	1525.000	1530.000	1535.000	1540.000	1545.000
Proposed C/L Levels	73.042	72.983	72.923	72.864	72.804	72.745	72.686	72.626	72.567	72.508
Existing Levels	71.585	71.546	71.618	71.669	71.729	71.761	71.751	71.741	71.771	71.718

Chainage	1550.000	1555.000	1560.000	1565.000	1570.000	1575.000	1580.000	1585.000	1590.000	1595.000
Proposed C/L Levels	72.448	72.389	72.330	72.270	72.211	72.152	72.092	72.033	71.974	71.914
Existing Levels	71.832	71.731	71.613	71.496	71.044	70.298	70.327	70.450	70.817	70.715

Chainage	1600.000	1605.000	1610.000	1615.000	1620.000	1625.000	1630.000	1635.000	1640.000	1645.000
Proposed C/L Levels	71.855	71.796	71.736	71.677	71.618	71.558	71.499	71.440	71.380	71.321
Existing Levels	70.044	71.362	71.546	71.503	71.459	71.417	71.377	71.339	71.304	71.228

Chainage	1650.000	1655.000	1660.000	1665.000	1670.000	1675.000	1680.000	1685.000	1690.000	1695.000	1697.376
Proposed C/L Levels	71.262	71.202	71.143	71.084							
Existing Levels	71.163	71.125	71.039		71.140						

Horizontal Geometry	L =87.407	R: 125.000 L: 86.213

Vertical Geometry	G =-1.187% L =187.516	G =-1.663% L =2.355

1:500 0 10m 20m 30m 40m 50m

1:1 0 10 20 30 40 50 60 70 80 90 100

Rev	Date	Description	By
A06	05.03.21	ROAD OUTLINE AMENDED FOLLOWING OCC COMMENTS	AN
A05	22.01.21	DESIGN UPDATED IN ACCORDANCE WITH OCC COMMENTS	DP
A04	07.01.21	AMENDMENTS MADE FOLLOWING OCC COMMENTS	AN
A03	24.07.20	ACCESS LOCATIONS AND LAYOUTS	NJH
A02	17.06.20	FOOTWAY AND CYCLE TRACK ALIGNMENT	NJH
A01	22.04.20	FIRST ISSUE	NJH

Amendments

Project
GRAVEN HILL, BICESTER

Title
EMPLOYMENT ACCESS ROAD
GENERAL ARRANGEMENT
SHEET 6

Client
Graven Hill Village Development Company Limited

5th Floor One Cornwall Street Birmingham B3 2DX
t 0121 212 7700
mail@watermangroup.com www.watermangroup.com

Drawing Status
PRELIMINARY

Designed by	JG	Checked by	DP	Project No
Drawn by	AN	Date	APR 2020	WIE11386
Scales @ A1 work to figured dimensions only		1:500		Computer File No WIE11386-EAR-90-100 to 106 - GA - A03.dwg

Publisher	Zone	Category	Number	Revision
WIE	EAR	90	106	A06

File Path \\s-bm\WIEL\Projects\WIE11386_GH0_LTA 2\#WO139_SERR_Got PO17_CAD\90_Civil\